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Surface Protection

through prevention of damage (surface management)

Focus: The Arctic Slope

May 17–20, 1977

Anchorage, Alaska

Edited by Margaret N. Evans

Published March 1978 by the

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Alaska State Office

555 Cordova Street Anchorage, Alaska 99501

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SESSION 8

Chairman: Edwin M. Rhoads
Transportation Research Analyst
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University of Alaska
Fairbanks, Alaska

WORKSHOP REPORTS

Introduction--Jules V. Tileston, Chief
Division of Resources
Alaska State Office
Bureau of Land Management
Anchorage, Alaska

The Proceedings of the Surface Protection Symposium are comprised of transcriptions of talks and discussions held at the Surface Protection Symposium and Workshop, sponsored by the Bureau of Land Management Alaska State Office, May 17-20, 1977. All transcriptions were edited for publication and the edited papers were reviewed by the speakers.

Views expressed are those of the participants and not necessarily those of the Bureau of Land Management or the U. S. Department of the Interior. Use of commercial names does not constitute an endorsement by the BLM or the USDI.

Welcome and Introduction

Welcome to our second symposium on surface protection. In January 1976 we had the first meeting on surface protection. The theme was, "Travel and Transportation Practices to Prevent Surface Destruction of the Northern Environment." We felt it was a success because a great deal of technical data was presented, and the quality of the presentations and the efforts of those who participated was of the highest. Some copies of the 1976 Proceedings are available for those who want them.

There are always some questions (and I have had them) as to whether or not all of the efforts of those who made presentations and put forth data are worthwhile and the information put to beneficial use after the symposium.

Shortly after last year's seminar, Congress passed the legislation that will transfer the Naval Petroleum Reserve No. 4 (PET-4) to the Department of the Interior. Surface protection responsibility of PET-4 was immediately transferred to the Bureau of Land Management. The BLM has had a crew, led by John Santora, that has been active in monitoring the surface activities. A lot of the information discussed at last year's seminar has been extremely useful to our people who are working on PET-4, as well as elsewhere in the State. So I can guarantee that if you presented papers last year, the information has been used and will continue to be used.

During the 1976 seminar, arctic and subarctic areas of Alaska were discussed. These include almost the entire State.

One objective of the seminar was to develop a comprehensive set of stipulations or specifications to cover the spectrum of situations arising in Alaska from use of lands.

Another objective was to develop continuity among the agencies using guidelines and stipulations in authorizations for travel and transportation across lands in Alaska. A final goal of the seminar was to define research needs for development of methods, practices, and equipment to prevent surface damage in the future.

These objectives were partially met. Basically, technical data necessary to develop some guide-stipulations were collected. The scope of the seminar, however, was too broad, and we were not able to develop specific stipulations from information presented then. We are not ready, and it probably is not practical or even feasible to develop stipulations for the entire State of Alaska since such a broad array of situations exists.

This year, therefore, we have determined to limit discussion of the theme, "Surface Protection through Prevention of Damage," to the Arctic Slope. Calling the 1977 meeting a symposium emphasizes the purpose of sharing technical information among specialists.

The symposium is to be followed by a two-day workshop to develop a working draft of all-season guide-stipulations attendant to all scenarios which may exist or appear in the future on the Arctic Slope.

Authors who presented papers in 1976 were asked to present papers at this year's symposium. The objective was to update the 1976 Proceedings to reflect the most current information. The agenda includes presentations from those who felt they had new data to present.

The 1976 Proceedings and information presented during this symposium will be the bases for the workshop sessions on Thursday and Friday. Along with these, some additional information will be distributed to the working groups. This will include some stipulations that have been used by the BLM or other agencies and copies of old or new legislation that has been promulgated by Congress. Probably the most important as far as the BLM is concerned is the Federal Land Policy and Management Act of 1976, commonly referred to as the Organic Act.

We hope that the objective of both the 1976 seminar and 1977 symposium to develop all-season guide-stipulations for use by all land management agencies concerned with the Arctic Slope can be accomplished at the end of this session. We do not believe that on an unseen site-specific basis, a

set of stipulations can be developed for every activity that poses a threat to the surface. We do feel, however, that a set of guide-stipulations can be developed that will generally cover all activities.

The all-season stipulations will need to be tailored for specific application and be made site-specific by the deletion of inappropriate portions. The major purpose for writing the guide-stipulations is to eliminate double or triple standards for users of land north of the Brooks Range.

We hope, too, that the sharing of technical information will continue beyond the symposium and that the interagency cooperation developing here will continue to grow as guide-stipulations being formed are honed and shaped to the greatest interagency usefulness.

Curtis V. McVee,
State Director
Bureau of Land Management
Alaska State Office

Keynote Address

The Alaska Arctic Slope– Challenge and Opportunity

Elbert F. Rice*

ABSTRACT
Those who are responsible for the challenges and opportunities on Alaska's Arctic Slope generally love the land but must supervise changes in it for development. The direct approach to change is not always the best. Sometimes, measures sincerely meant to help the environment hurt it. An example is wildfire and efforts to stop it completely. New ideas often come from outside a particular field. For example, satellites that revolutionized weather forecasting were not built by forecasters. Actions that affect the environment are not always detrimental. Those who write regulations and enforce them should be wary that they do not stifle advances that would help mankind.

I don't know, ladies and gentlemen, what it takes to be a keynote speaker. Because I didn't know when I undertook this commission, I looked up last year's notes and found that the keynote speaker was Curt McVee. I read what he had to say, and I also read what you people had to say during the conference. I must say that I am humbled by all of

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this, partly because I readily found out that of all the people here, I know the least about the subject we are assembled to investigate this morning.

As will perhaps become evident, the fact that I am an outsider may not be entirely detrimental to this meeting. I want to leave you with two or three important thoughts.

First of all, I would like to point out that one of the reasons I am here is that I have a number of friends in the audience. I hope that by the end of the day, I have many more. We have mutual interests. Unfortunately, those mutual interests tend to make us all a little schizophrenic. We are here probably because we love Alaska, because we love a frontier (if such a thing remains), because we love the outdoors. And we are here to preside over the development, or change if you will, of that outdoors into something we fled some years ago. We are here to oversee the disturbance of those things that we appreciate the most.

One of the thoughts I want to leave you with is that the direct approach to doing whatever it is we wish to do is not always the best approach. For example, the direct approach in some areas is absolutely the wrong one. You ladies are probably the best people to tell us about this. You are well aware that in search of a mate, the very last thing a woman wants to do is to announce to the menfolk that she is in search of a particular one. That would send him chasing over the nearest bridge, and she'd never see him again.

Once I was interested in sailing. I was young, I thought I was a rather good sailor, and I had a sailboat. I also had a girl. Although she was sort of a "nodding acquaintance," I was interested in making good impressions. I left the landing and sailed downwind quite a way. Probably because she had discerned things she didn't like about my personality, and certainly because she had discerned the things she didn't like about riding in a sailboat in a fresh breeze, she wanted to go back--now. So I headed back. Going back against the wind in a sailboat is a process of going sideways. I tacked this way and that way, each time making a few more yards in the direction we needed to go. She was irate. She was certain that the way to get back was to point the boat that direction. I never did convince her that I wasn't trying to delay the moment when she would reach salvation by going somewhere else first.

I am suggesting that sailboats are not the only things that must avoid the direct route. Another example is hunting with gun or camera. Certainly the direct approach--heading right for the animal you wish to meet--is the wrong approach. It is the method least well suited to get results. The hunter must instead be a little clever. He must go, perhaps, off to one side or up this or that gully, or test the way the winds are blowing. I submit that that's important for us to know, no matter what our job might be.

The direct or obvious approach seems to me to have characterized a great deal of American life in the last few years, but it is the one most unlikely to get us where we really want to go.

The last example of this is something that I am sure has influenced you a great deal and probably caused you a bit of soul-searching (as it has me). Years before I came to Alaska, I encountered in an obscure scientific magazine something that shook my faith not only in education but in conservation and perhaps religion and other things one holds dear. I discovered something about forestry that I had never realized, and it distressed me. I had been brought up carefully to believe that one should stop forest fires. Not only should one stop all forest fires, but one should stop them before they start, if possible.

But some scientist, an expert like the people here, had discovered that in the past, fires started periodically by people or lightning had wiped out the grasses and underbrush in certain great forests of the Southwest. The fires kept the forests clean and allowed trees to grow in a parklike atmosphere. Grass grew again and the trees were widely spaced, separate, and mature. In those forests, great populations of animals assembled and presumably lived happily except for occasional harassment by the hunters who visited there.

But when we learned about stopping forest fires, even in the days before Smokey Bear, we stopped them all. The unexpected result was that the underbrush grew to the point that, when a fire inevitably did start, it became a conflagration that was impossible to stop. Such fires destroyed not only the underbrush but also the trees we were trying to protect.

This disturbed me a great deal for another reason: As the BLM sometimes must feel, I didn't want to appear to encourage people to be careless about fires. If we say,

"Well, we really shouldn't stop all forest fires; we should have prevention-burns from time to time to keep down the underbrush to avoid a conflagration,"--the public may think that flipping a cigarette into the forest is all right. We wouldn't want to see that happen. On the other hand, can we continue to say, "Never allow a fire in a forest," when we know that the result will be another great fire or series of fires like those in Oregon? (The Tillamook burns there destroyed the livelihood of thousands of people and the wealth of Oregon for many years. Fires there burned every seven years for thirty-five years after the original burn.)

All this happened because we didn't really know what we were doing when we took the direct approach. We simply said, "Stop forest fires," and that's all.

Another idea is that great advances do not always come from within a group of experts. Sometimes a person like myself, who knows less about this topic than any of you, might have something worthwhile to say. Here are some examples:

Suppose it is your business to know about weather. You are employed by the Weather Bureau and you want to do the best you can for weather. If you'll look back 20 years, you'll see that the "best thing" was thought to be more weather stations, more weather reports, and better communications between the weather stations and central areas with well-educated forecasters. You might recommend these same things, since they're all you know. But some other person, not even thinking about weather, may have managed to put satellites into the sky, placed cameras in the satellites, and made it possible for the weatherman to get <u>much</u> <u>better</u> weather coverage of the world with far <u>fewer</u> stations. The weathermen, geniuses though they might be, could not have done it by themselves. Such an advance in weather forecasting had to come from elsewhere. And it has.

Another example: When one thinks of mathematical computation, one thinks of mathematicians. Surely, advances in computation should come from mathematicians whose whole lives are devoted to the development of just that sort of thing. As we all know, the advances in computation have <u>not</u> come from the mathematicians. They've come from the designers of computing equipment, and a computer now can do in seconds what mathematicians used to take years to do.

John Napier, the inventor of logarithms, was a fine mathematician. After inventing logarithms, he concluded

that they were so valuable in easing the computational load of scientists, engineers, and others, that he spent the rest of his life calculating logarithm tables. He didn't feel his life was wasted, for he made things easier for others. The ironic fact is that for less than $100 any of us can buy a pocket calculator and in seconds develop the logarithm tables that took Napier a lifetime. Furthermore, we don't *need* logarithms very often because a machine makes the calculations for which logarithms once were needed.

Mapping is another example that should be dear to the hearts of those associated with BLM. Some of the answers to topographic mapping problems have not come from surveyors, cartographers, or geographers. Instead, they have come from technicians who developed airplanes and cameras. Their interest in mapping followed their interest in aviation and photography. Their combined talents, however, have brought us a new science, photogrammetry, that has been incorporated in mapping, or cartography, and geography. Cartographers could not have done this by themselves. The idea for photogrammetry did not originate with them, but had to come piecemeal from elsewhere.

Let's see if we can apply something from these examples to our situation here, the Arctic Slope surface protection symposium 1977. I am reminded of the fellow who fell over the cliff. In true cartoon form, he managed to catch a shrub halfway down the cliff and then had the problem of how to get up or down. There wasn't any way, so he just hung on. His arms were getting so tired that he was going to have to let go. He knew it would mean his death. So he shouted, "Help! Is anybody up there?"

A deep voice from the thunderclouds said, "I am here, my son. Do you have faith in the Lord?"

"Yes, yes, I have faith!"

"I will save you. But first, you must release your hold."

There was dead silence. Then, in a chastened voice, the man shouted, "Is anybody *else* up there?"

I would like to make an observation. Man's influence on the environment is not always detrimental. It only *seems* to be detrimental at first. I must confess that, like most people, I can't think of any effect man has on the arctic tundra that doesn't seem detrimental to me. On the other

hand, as I look around Europe and the central parts of the United States, I see that the landscape is nothing whatever like it must have been just after the Ice Age when it, too, was arctic tundra. It has changed enormously. It changed every time a grazing animal approached dominance, every time thunderstorms started fires that swept through the grassland and prevented shrubs from coming up. And it changed under man's plow.

The Great Plains became the Great Plains largely because of fire (I am told) and the grasslands resulted in the production of many buffalo. I've been taught since I was knee-high that the buffalo were destroyed by people with guns who carelessly killed the animals, for nefarious reasons. One reason was the lust to kill; one was a desire to deny the Indians sustenance so that they could be more easily controlled, and one was to exploit a ready source of leather for the world market. There may have been other reasons as well.

It wasn't until I reached college that I discovered a truth that negates all these other truths: The buffalo would be just as dead if never a one had been intentionally killed. The decline of the buffalo was due to the decline of habitat and not all due to the shooting, but to the plow. As a matter of fact, shooting, or harvesting, the buffalo, is the only way we could have saved them from starving, after their environment was destroyed. So you see, man's effect on the buffalo was total and immediate, but it had nothing to do with the traditional shibboleths we tell one another.

If we had had the environmental consciousness then that we have now, we might have said that we must not upset the balance of nature by killing buffalo. I suppose, ideally, we would have had to limit the population of this continent to a few hundred thousand. But by changing from buffalo to corn in the Great Plains, we have become able to support more than 200 million people in conditions of prosperity and peace, where formerly a few hundred thousand people were supported in poverty, occasional starvation, and continuous war.

That's not to be ignored: The fact that man enters and disturbs the environment is not necessarily evil. I must confess an inability to see how the Arctic Slope can be developed in the manner of the Great Plains. I don't see us parceling out the Slope by "160 acres and a mule" and developing food for more people than are there now. I <u>do</u>

see great displacements caused by the fact that people are less able to pursue the subsistence hunting economy that used to support those who lived there.

A little history is perhaps in order here. When the first Arctic Slope census was taken during the first International Polar Year in 1883, about 4,000 people lived between Point Hope and the Canadian border. Today about 4,000 people still live in the same area, except for those who are connected with oil development. The difference is that the 4,000 people who were there in 1883 were not only spread thinly across the Arctic Slope but they moved continually, to catch fish when the fish were running, to get the caribou when their furs were prime, to do some whaling to get meat for the winter, and so forth. This all declined as trading posts, missions, hospitals, and schools were built. Now we find that the 4,000 people are concentrated largely in Barrow, with small villages at Wainwright, Nuiqsut, Kaktovik, and Point Hope. None of these people now survives solely on a subsistence economy--none. They are surviving now on something else. Some of these "something elses" cause you and me a great deal of soul-searching. Many of these people are "on the dole" because there is no other way for them to make a living. This distresses us somewhat, and it distresses them a lot. They are not in a position to do much about it. You and I are in a position to do something; but I'm not sure that you and I know what we ought to do.

Europe and central North America have certainly suffered a man-caused change in their environment. There are spots in Europe where the environment is greatly superior, and I think the Midwest is greatly superior to what it was before man changed the environment. In the centuries that have gone by while these changes were occurring, we didn't know what we were doing. It is my hope that the centuries ahead will be characterized by people who <u>do</u> know what they are doing, and that means you.

My last point is more or less the title of this symposium, "The Arctic Slope Surface Protection--Challenge and Opportunity." The challenge, I guess, is whether we can protect the surface and still promote prosperity. Can we? If there are no mines, no oil extractions, no roads, there certainly is no way of supporting all the people in this or any other country. If we can't support people, we certainly cannot support government.

So surface protection is to the interest of all of us, whether we are in the private sector, worried about the infringement of government on individual freedoms, or whether we are in government, supported by the taxes of these same people. We must promote the maximum of prosperity with the minimum of destruction to the environment. That makes continued survival possible. That's our challenge and our opportunity.

I wonder if we all realize the enormous power we have when we write stipulations and regulations. It's far more influential than most people realize. This has come home to me as a university professor. (That's a bureaucrat only once-removed, I guess.) Since you are also bureaucrats, we are in this together. We write stipulations for the best reasons we know. But there is a catch. When we write a stipulation it's easy to say, "Well, you know, we can't degrade stream quality, visual quality, environment for fish spawning, and so forth." We can't allow those to degrade one iota; we must write stipulations that prevent such degradation, and we do. We had the elevating spectacle for several years now of sewage treatment plants which were temporarily, or maybe continually, incapable of handling the load on them. The result was that we have shipped sewage sludge by air from the Arctic Slope to Fairbanks to be discharged there. The Fairbanks situation was at that time far worse than in the Arctic. We were bringing more sludge to an area where 50,000 people were already supplying organic pollution to an overloaded stream. In an effort to keep organic materials, including certain soluble components like nitrogen, from reaching the environment on the Arctic Slope, we moved them elsewhere. Not one of us here really believes that our stipulations were necessary or wise, but we, the people of this country, paid hundreds of thousands of dollars for just such idiocies. Why? Because we, those same people, outsmarted ourselves by writing stipulations that say, "Thou shalt not pollute." We didn't allow opportunity to develop an alternative.

If anyone wants to do something, like mine gold, drill an oil well, place a road, or for other reasons disturb the public domain of this or any other State, he must write an environmental impact statement, in order that people who must judge his actions can determine whether the actions will be tolerable, subversive, or whatever. I sometimes wonder if we shouldn't have the equivalent of an environmental impact statement for a regulation.

From the time I was very young, I learned some interesting things about politics and environment. In Britain a famous example is the window tax. This was in the days when the only people who could have glass windows were the prosperous ones. In our continuing effort, which is at fruition today, of soaking "them-that-have" in order to spread the wealth among "them-that-have-not," windows were taxed. This resulted in an entire change of architecture. Buildings from that era are characterized as having few and small windows. They were very dingy and miserable places to live in, I am told. Some of these have been preserved as examples of what can happen when we can make regulations without fully anticipating the consequences.

You probably have your own favorite examples. Remember the flap about phosphates, a later flap about cyclamates, the current flap about saccharin? I fly from time to time, and I can think of a dozen cases where the FAA in an effort to do something right in effect has done just the opposite. A friend of mine said the other day, "Do you realize that the airplane engine you're depending upon was designed in 1936?" I answered, "So what?" He replied, "Well, you know, it's left that way because the government, in trying to make airplane engines safe, has put such great effort into making sure that nobody does anything that isn't tried-and-true. Nobody can afford to design and build a new engine now. They must be built as they used to be built. From time to time we'll make it a little stouter here or adjust the fuel system there or something, but we won't change the basic idea. As a result, our engines are poorer than they need to be."

As I look back, I can see that he is right. We are using 40-year-old engines, 40-year-old designs, not <u>in spite of</u>, but <u>because of</u>, the desire to be safe. We might be considerably safer if we hadn't had these regulations. The only change in concept of aircraft engines was the jet engine. This was a revolution, and it didn't come from the FAA. It came from the British during wartime, when experiments could be made. More people are carried behind jet engines now than ever were carried behind reciprocating engines. They are safer in that, instead of 1,500 hours per engine lifetime, jets can go 4,000 hours or more between overhauls. Their record indicates they are far safer than the expensive windmills we have been using.

I'm sure you see the point: Sometimes our regulations have an effect exactly the opposite from that for which they were intended.

If this is going to be a challenge, we've got to have an opportunity. The opportunity is to conserve, not necessarily to preserve, that which we have; to show wisdom to temper the power that we who have the power to write stipulations can manipulate. You know it is within our power to destroy Prudhoe or to make it prosper, just by our interpretation of an order that we innocently made a year, two years, ten years ago. That's a pretty awesome power indeed! Elected officials rarely have that kind of power. Our responsibility is far greater than most people realize.

We tend to look at this or that little portion of the job and say, "Well, it says here on page 56 (a), second paragraph, that so-and-so. And you sign a stipulation agreeing to this and therefore you'll do so-and-so." Whether it's reasonable or unreasonable makes not a bit of difference to some people; I hope there are no such people here.

On the other hand, if you use your own judgment and say, "Well, we can bend our interpretation of that one a little bit," you can get into a heap of trouble, not from the world but from immediate superiors. As a matter of fact, we can find ourselves with a pink slip down the road because we had not followed the orders we were bound and maybe sworn to uphold. So you see, it's not always simple to do the right thing, and we don't always do the right thing. But it's our duty to try.

I would like to paraphrase a prayer by Peter Marshall, the late, great chaplain of the Senate. He said, "God give us the serenity to accept those things we can't do anything about; the courage to do those things we can, and the wisdom to know the difference."

New Directions for the Federal Establishment from Congress and the Courts

Jack Allen*

ABSTRACT
The Solicitor's Office has been working with the BLM to promulgate regulations for guidance in administering the landmark Federal Land Policy and Management Act of 1976, the long-awaited BLM Organic Act. Four Supreme Court decisions in 1976 helped define the Federal Government's role in surface protection. While the framers of the Constitution intended the State to be the basic unit of government for land surface protection, the Supremacy Clause, or Preemption Doctrine, has caused some State and Federal legislative conflicts. Most laws governing public lands were enacted under the Property Clause of the Constitution. Before 1976, most statutory authority for land management was nondiscretionary and enforcement was cumbersome and weak. The Organic Act, designed to remedy these problems, remains to be tested in the courts. Section 302 of the Act gives the BLM broad discretionary authority to manage lands under principles of multiple use, sustained yield, and in accordance with the land use plans developed. Various

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provisos attached to the Section are confusing. Only three court decisions have so far construed the Organic Act; Alaska is involved in all of them.

I was going to start out with a dramatic statement that 1976 was a landmark year in terms of surface protection of Federal lands in Alaska, and try to catch your attention. It also is the year that I came to Alaska, but that is not why it was such a landmark year. The Bureau of Land Management (BLM) Organic Act was enacted by Congress in October 1976. This is an Act that we in the Federal Government had long been awaiting. Now that we've got it, we're not sure what to do with it. The Solicitor's Office is working very hard with the BLM in Washington, trying to promulgate regulations which will give us some guidance.

Also in 1976, the Supreme Court handed down four significant decisions defining the Federal Government's role in the area of surface protection, and the relationship, in that area, between the Federal Government and the State.

Before we get into the decisions and the BLM Organic Act, I'd like to discuss briefly the origin of the Federal laws for surface protection. The United States Constitution attempted to establish the States as the basic unit of government. The Federal Government's role was intended to be rather limited. Although sometimes it seems not to have worked out that way, the idea of the Constitution was that the Federal Government would have certain specifically enumerated powers. These powers would be construed narrowly and strictly, and all powers not granted to the Federal Government would be retained by the States. The State would be the basic unit of government for purposes such as surface protection of lands.

There are three types of Federal jurisdiction over land. The first is fairly rare. It's exclusive jurisdiction, where there is no State jurisdiction at all. In Alaska the only area of Federal exclusive jurisdiction is Mount McKinley National Park, which was set aside in the Statehood Act as an area of exclusive jurisdiction.

The other type is concurrent jurisdiction under which the Federal Government and the States exercise jurisdiction concurrently, generally under a statute which spells out the areas where the States or the Federal Government can exercise legislative jurisdiction.

The third type is more familiar to us. That is the jurisdiction derived from Federal ownership of land. It's based on the Property Clause in the Constitution. The Property Clause says that the Federal Government shall make all needful rules and regulations respecting property belonging to the United States.

Under this type of jurisdiction, the Federal Government is envisioned simply as the landowner with the same basic rights as other landowners, but with some significant differences. The most significant difference results from another clause in the Constitution, called the Supremacy Clause. This provides in effect that when the Federal Government legislates in an area within its jurisdiction, any State rule or law to the contrary shall be unconstitutional and unlawful. This so-called Preemption Doctrine gives the States a good deal of trouble from time to time. I think we'll hear from Jeff Lowenfels about some problems it causes.

The courts are quite reluctant to apply the Preemption Doctrine. They try hard to construe a State law so that it does not conflict with a Federal law. Because of this, we sometimes get rather tortured constructions of State laws. The courts don't like to hold a State law unconstitutional.

Federal legislation under the Property Clause applies only to Federal lands. But Federal legislation for surface protection frequently applies to non-Federal lands under a different constitutional provision: the so-called Commerce Clause which gives the Federal Government exclusive jurisdiction over interstate and foreign commerce. Most of the environmental protection laws are enacted under the Commerce Clause and apply to all lands. There is a fairly significant difference between legislation enacted under the Property Clause and legislation enacted under the Commerce Clause.

Most of the laws governing public lands were enacted under the Property Clause. The first two really significant laws of this type were the Mining Law of 1872 and the Homestead Law. Neither of those laws had provisions in them for surface protection, and both of them operated essentially as nondiscretionary disposal statutes, in contrast, for example, to the Mineral Leasing Law, which was a discretionary law.

The problem that land managers traditionally faced before 1976 and, to some extent still face, is how to build

surface protection provisions into nondiscretionary land disposal statutes such as the Mining Law.

The National Environmental Policy Act (NEPA) of 1970 provided for the Environmental Impact Statements that we are all familiar with. It also established as a national policy the concept of environmental protection, which was intended to be included in all Federal land management activities. Again, a considerable amount of uncertainty exists as to what extent this later enactment by Congress, mandating environmental protection and surface protection consciousness, can be used in the context of nondiscretionary disposal statutes such as the Mining Law. Was NEPA, for example, intended to amend or modify the way the mining laws were administered? The simple answer is "No," but we have, through our general management authority, made certain inroads into the traditionally inviolate area of the Mining Law. For example, our off-road vehicle regulations to some extent affect the way a miner can get to his land.

The basic problem that land managers faced before 1976 was twofold: (1) Much of the statutory authority was nondiscretionary; and (2) Enforcement was cumbersome and fairly weak. When a rule or regulation was violated, the only recourse we had usually was to go to the court and get an injunction to stop the violation. If the person violated the rule again, you could go back to the court and ask that he be held in contempt. Before he could actually be punished, he had to violate the rule twice. Each time you had to go to court and get a court order. Although there was a way to stop trespass damage, it was equally cumbersome and time consuming.

Earlier this month I went to a conference held in Denver by the American Bar Association on the BLM Organic Act. The four lawyers from the Solicitor's Department and the attorney for the Senate Committee that had passed the legislation all were on the panel. They presumably know as much as anyone about what the Act was intended to do. I think the universal conclusion from the conference was that there are a lot of good questions but, as yet, very few good answers.

So far, only three court decisions have construed the Organic Act. Two of them involve the wolf hunt in Alaska, and the third involves a BLM right-of-way for an electric transmission line in Anchorage.

The intent of the Organic Act (or FLPMA as it is also called) was to solve the two basic problems that I mentioned earlier. First, it repealed most of the nondiscretionary land disposal statutes and replaced them with a discretionary form of management authority, lease permit authority classification, land-use plans, and that sort of thing. This type of authority allows the manager to take into consideration the requirements of surface protection.

And second, FLPMA also was intended to give enforcement officers more up-to-date authority, including arrest authority and the authority to carry firearms. This latter provision was one of the most bitterly contested provisions in the Organic Act. The Western States were very much against the idea of a BLM police force.

The authority to carry firearms in the provision seems to apply only to the local sheriffs who already have the authority to carry firearms. Therefore, it is unnecessary. But the Department has construed that provision in the Act, which is Section 303, as giving BLM the authority to make arrests on the land and carry firearms in carefully controlled circumstances.

The Mining Law was not repealed by the BLM Organic Act. Another hotly contested provision of the Act is one that requires all mining claims to be recorded within three years of the date of enactment or be conclusively presumed to have been abandoned. Traditionally, an unpatented mining claim has been regarded as a property right, which Congress cannot subsequently impair without compensation. We already have a lawsuit here in Alaska on a similar provision in the Alaska Native Claims Settlement Act that requires recordation of mining claims. It is actually a very limited provision. It does not go as far as the Organic Act provision in that it doesn't say that if you do not record the claim within the time allowed you will be presumed to have abandoned it. All it says is that if you don't report it within the time permitted, you must go into a State court and sue the Native Corporation to enforce your rights. In other words, you haven't lost your rights. It's just that you have to go to a State court rather than to the BLM to get a patent for that mining claim.

Section 302 of the Organic Act is the section giving the BLM broad discretionary authority to manage the lands under the principles of multiple use and sustained yield and in accordance with the land-use plans developed.

One of the big questions is to what extent this broad authority can be used to restrict the rights of miners, which is the single nondiscretionary disposal statute that is still on the books. The authors of the Act tried to address that question with a proviso in Section 302 which says: "[Nothing in] this Act shall in any way amend the Mining Law of 1872 or impair the rights of any locators of claims... including...rights of ingress or egress."

This seems to state clearly that the Mining Law is inviolate, as it always has been. The authors, however, added a proviso to the proviso, which says, "The Secretary shall...take any action necessary to prevent unnecessary or undue degradation of the lands." That sentence expressly applies to the Mining Law.

I think we can expect some litigation to decide what is "undue and unnecessary degradation." I think the conclusion has to be that the Mining Law has been to some extent modified by the BLM Organic Act.

Now I'd like to talk about the two Supreme Court decisions that I mentioned. The first held simply that the Wild Horse and Burro Act of 1971 was not an unconstitutional invasion of State authority. That statute requires BLM to protect wild horses and burros on public lands. The State of New Mexico had passed a law permitting State officers to round up stray horses in the State that were interfering with the domestic livestock. The horses were auctioned off and slaughtered. A New Mexico rancher who had a permit to graze on Federal land notified the State Livestock Board that some wild horses and burros at a well he was using were interfering with his cattle. The State came in, rounded up the horses, and auctioned them. BLM found out about it, wrote the State, and demanded that the horses be returned to the public lands. The Supreme Court held that this was a constitutional exercise of BLM's authority.

The result may sound logical but it's not the result that a three-judge District Court had reached in the initial decision in the case. The three-judge District Court had held that the Wild Horse and Burro statute was, in fact, unconstitutional because it infringed upon the traditional State jurisdiction over resident wildlife species.

The District Court had taken a rather narrow view of the Constitution, the same view the founding fathers took--that the powers granted the Federal Government were limited, and all powers not expressly granted were reserved to the

States. So the District Court judges looked for the basis on which the Federal Government had enacted this statute, and they couldn't find any. The Supreme Court decision had held that there were two legitimate bases for legislating under the Property Clause. One was to legislate with respect to things that the Federal Government actually owned, and the other was to legislate to protect the land. It was clear that the Federal Government did not own these wild horses and burros. It was also clear that the regulation of wild horses and burros was not to protect Federal land but to protect the horses.

Since it could not find a constitutional basis for Federal jurisdiction, the District Court held that the law was unconstitutional. The Supreme Court reversed the decision, not on the grounds that the horses were Federal property or that the regulation was intended to protect Federal property, but on a very loose reading of the Property Clause which the Supreme Court held gave Congress the right to regulate Federal property <u>and</u> incidences or ancillary activities on that Federal property. The Supreme Court held that Congress considered these horses to be in effect a part of the Federal land, even though they were not actually Federally owned.

The other decision is the wolf-hunt case. As you may know, the suit was originally filed in the District of Columbia. Defenders of Wildlife brought suit against the Secretary to get the court to order the Secretary to order the State of Alaska not to shoot wolves on Federal land. The Department defended on the traditional grounds that resident wildlife species were under State jurisdiction and that the Department had no authority to tell the State it could not regulate the wolves on Federal land.

Judge Gash in the District of Columbia disagreed with the government. He cited the Organic Act as the authority for his holding that the Government <u>did</u> have that authority. He ordered that it be exercised. The Organic Act has a provision, 302, which is a little ambiguous. It says, "[Nothing in] this Act shall be construed as...enlarging or diminishing the responsibility and authority of the States for management of fish and resident wildlife." From that sentence, one would think that the status quo had been preserved and the traditional view of the State's jurisdiction over wildlife was maintained. Again, however, there's a proviso to the proviso: "However, the Secretary concerned may designate areas of public land..., and establish periods when, no hunting or fishing will be

permitted for reasons of public safety, administration, or compliance with provisions of applicable law."

In the District of Columbia District Court, the government took the view that this exception was very limited--"for reasons of public safety, administration, etc."--and that the situation in Alaska didn't fit that exception. But as I said, Judge Gash disagreed.

The Secretary, therefore, sent a telegram to the Governor of Alaska asking him to stop the hunt. Alaska responded by going to the Federal Court here in Anchorage and, in effect, asked the court to order the Secretary not to order the State not to hunt.

The Federal District judge in Anchorage, Judge Von der Heydt, agreed with the judge in the District of Columbia that BLM does have authority under the Organic Act to control resident wildlife species.

Recent Court and Congressional Actions

affecting

air and water quality and land management authority

William J. Moses*

ABSTRACT
Section 118 of the Clean Air Act and Section 313 of the Water Quality Act left questions as to limits of State and local jurisdiction. Executive Order No. 11752 ordered Federal agencies to comply with substantive standards of all environmental statutes, but stated that Federal facilities need not comply with procedures, including permit requirements. In 1976, Supreme Court decisions affirmed that Federal facilities need not comply with State permit requirements, but did not decide the question of whether or not third parties operating under leases on Federal lands must comply with State procedural requirements. The Resource Conservation and Recovery Act of 1976 was the Congressional reaction to the Supreme Court decisions, as far as solid waste disposal is concerned. Concerning enforcement authority, Public Law 94-586, The Alaska Natural Gas Transportation Act, gives specific enforcement authority relating to a gas pipeline in addition to the BLM Organic Act. Wording in the new Public Law, however, leaves some questions of authority unresolved.

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When we talked to this group last year, both Bob Price, the former Regional Solicitor, and I mentioned that among a number of cases pending in the United States Supreme Court, two were attracting considerable notice in the Lower 48. A lot of State attorneys general were filing what we refer to as "amicus" briefs, "friend of the court" briefs, in these cases. One of the cases involved the Clean Air Act, 42 U.S.C. § 1857 et seq, specifically the provisions of Section 118 thereof; the other involved the Water Quality Improvement Amendments of 1972, 33 U.S.C. § 1251 et seq.

The section of that statute which was being argued about in the Supreme Court was Section 313. Section 118 of the Clean Air Act and Section 313 of the Water Quality Act are essentially similar. They state: "Each Department, agency, [and/or] instrumentality of the executive, legislative, and judicial branches of the Federal Government (1) having jurisdiction over any property or facility, or (2) engaged in any activity resulting, or which may result, in the discharge [or runoff of pollutants/of air pollutants] shall comply with Federal, State, interstate, and local requirements respecting control and abatement of [air] pollution to the same extent that any person is subject to such requirements..."

A legal battle has been fought in the Federal Courts in different parts of the country over what this language means. In 1973, Executive Order No. 11752 was issued which provides in Section One thereof that compliance by Federal facilities with Federal, State, interstate, and local substantive standards and substantive limitations, to the same extent as any person subject to such standards and limitations, will accomplish the objective of providing Federal leadership and cooperation in the prevention of environmental pollution, but that in light of the principle of Federal supremacy embodied in the Constitution, the Executive Order was not intended nor should it be interpreted to require Federal facilities to comply with State or local administrative procedures in respect to pollution abatement and controls.

So this was the battleground. The President of the United States had ordered Federal Government agencies to comply with substantive standards of environmental statutes, whether Federal, State, or local. He had said, however, in his Executive Order, that the Order was not intended to mean that Federal facilities have to comply with procedural aspects of State or local statutes.

Obviously it was in the area of procedures that the trouble developed, and the question was simply this: Did a Federal facility have to comply with the permit requirements that most States have, either under the Clean Air Act, Water Quality statutes, or the like? The Executive Order obviously took the position that Federal facilities did <u>not</u> need to comply, and this was the position that the Federal agencies took in the litigation that subsequently ensued.

The decisions in the District Courts and the Courts of Appeals went both ways. We had conflicting decisions, depending on which Federal circuit you were in. The cases were then consolidated and went before the United States Supreme Court. I believe I commented last year that with the makeup of the Court and a growing conservative approach on some of the decisions coming down from the Supreme Court, it would be interesting to see how the court would handle this problem, which is a fundamental problem of State-Federal jurisdiction.

In June 1976 the United States Supreme Court came out with the decisions, <u>Hancock vs. Crane, 426 U.S. 167; EPA vs. California State Water Resources Control Board, 426 U.S. 200</u>. The Supreme Court, in identical 7 to 2 decisions, took the following position: There is no question that under the applicable Federal law, Federal facilities must comply with substantive State air or water quality standards. However, Federal facilities do <u>not</u> have to comply with State permit requirements, since those requirements are considered merely procedural.

Now it is equally important to consider those issues not reached by the Court. The Court did not reach the question of whether third parties operating under leases, permits, or contracts on Federal land have to comply with State procedural requirements. Clearly, it would appear that if a Federal agency itself has to comply with State substantitve standards, a third party located on Federal land would also have to comply with State substantive standards. However, the Court did not address the question of third party compliance with State permit requirements, that is to say, the procedural aspects of State environmental laws.

Before leaving the two cases I should point out that while not specifically addressed by the Court, the issue of third party compliance with State procedures is nevertheless raised by the very statutes that the Court had before it for review. The term "facility" found in both Section 118 of

the Clean Air Act and Section 113 of the Water Quality Improvement Amendments apparently is used in a broad context similar to that of Executive Order 11752, which talks in terms of "facilities." The term "facilities" in the Executive Order is defined to mean the buildings, installations, structures, land, public works, equipment, aircraft, vessels, and other vehicles or property owned by the Federal Government, or constructed or manufactured for the purpose of leasing to the Federal Government. Therefore, under these statutes, "any property or facility" means federally owned land itself. So activities by third parties taking place on Federal land could raise this issue once more, and I feel certain that we are going to see more decisions directed to this unanswered question, namely, do third parties conducting activities on Federal land have to comply with the procedural aspects of State environmental laws?

Shortly after the decisions came down from the Supreme Court, Congress passed another statute that I think all of you should be aware of because it was a Congressional reaction to the Supreme Court decisions in Hancock and EPA. The technical name of the new statute is the Resource Conservation and Recovery Act of 1976. We refer to it as the Solid Waste Disposal Statute. I'm sure that those of you who are familiar with some of the problems that the Navy got itself into up at PET-4 will recognize that this is the statute involved.*

This statute begins, "Each Department, Agency, Instrumentality, Executive, Legislative, and Judicial branch of the Federal Government..." So you see, it's the identical lead-in language as Sections 118 of the Clean Air Act and 313 of the Water Quality Act. "...having jurisdiction over any solid waste management facility or disposal site, or engaged in any activity resulting in or which may result in the disposal of solid waste, shall be subject to and comply

*Note: Although an update on this topic in 1978 would undoubtedly highlight 1977 Congressional enactments, it should be noted at this time that Congress, in Section 116 of the 1977 Clean Air Act amendments, P.L. 95-95, 91 Stat. 711, has changed the critical wording of former Section 118 of the Clean Air Act to specifically require Federal facilities, employees, etc., to comply with procedural requirements of State law, including permits. The legislative history of this section indicates a specific intent of Congress to overrule the Supreme Court decision in Hancock v Train.

with all Federal, State, interstate, and local requirements..." Up to that point we are tracking the other statutes. The change, both substantive and procedural, is, "...including any local requirements or permits."

Last fall on October 21, [1976] Congress answered the question as far as solid waste disposal is concerned. Now there is a provision for Presidential exemption, but if you read the statute, the possibility of getting a Presidential exemption is rather narrow. Exemptions have to be reported to Congress every year and this sort of thing.

The legislative history of this statute indicates that this is clearly a change in what the law used to be. There's a discussion of the Supreme Court decisions, indicating the distinction made by the Supreme Court between the requirement to comply with the substantive standard and the lack of any requirement to obtain a permit. So at least in this area, we know what the law is. This is not to suggest, however, that there may not still be Federal/State jurisdictional issues even with regard to waste disposal on Federal land.

The only other comment I have to update our discussion of last year concerns enforcement authority. What sort of enforcement authority does the Federal Government have on public lands? Basically, what authority does the BLM have on public lands to enforce surface-type stipulations and the like, other than some sort of contractual controls?

I would like to call your attention to Public Law 94-586, passed late last year, which is the Alaska Natural Gas Transportation Act.

There is an interesting provision in that statute, in Section 11, Supplemental Enforcement Authority:

"11(a) In addition to remedies available under other applicable provisions of law, whenever any Federal officer or agency determines that any person is in violation of any applicable provision of law administered or enforceable by such officer or agency or any rule, regulation, or order under such provision, including any term or condition of any certificate, right-of-way, permit, lease, or other authorization issued or granted by such officer or agency, such officer, or agency, may (1) issue a compliance order requiring such person to comply with such provision or any

rule, regulation, or order thereunder or (2) bring a civil action in accordance with Subsection (c).

"(b) Any order issued under Subsection (a) shall state with reasonable specificity the nature of the violation and a time of compliance, not to exceed thirty (30) days, which the officer or agency, as the case may be, determines is reasonable, taking into account the seriousness of the violation and any good-faith efforts to comply with applicable requirements.

"(c) Upon a request of such officer or agency, as the case may be, the Attorney General may commence a civil action for appropriate relief, including a permanent or temporary injunction or a civil penalty not to exceed $25,000 per day for violations of the compliance order issued under Subsection (a). Any action under such Subsection may be brought in any District Court of the United States for the District in which the defendant is located, resides, or is doing business, and such court shall have jurisdiction to restrain such violation, require compliance, or impose such penalty or give ancillary relief."

So there is, in addition to the BLM Organic Act, specific enforcement authority as it relates to a gas pipeline.

Note that the wording of the section does not claim to limit itself merely to the Alaska Natural Gas Pipeline project. It simply says, "...violation of any applicable provision of law..."

A question was raised in the Conference Report on this statute as to whether this was an oversight by Congress and whether Congress really intended to include some limiting language and say that this is limited to authorizations issued under that statute. Despite that warning in one of the letters from one of the executive agencies to the Committee, Congress passed the language as originally drafted. An interesting legal question now is whether or not Federal officials have another source of enforcement authority even for projects not connected with the gas line.

Alaska State Perspective on Environmental Laws—A Brief Update

Jeffrey B. Lowenfels*

ABSTRACT
State assistant attorneys general are divided in their opinions as to the significance to State and Federal jurisdiction of the Supreme Court decision on the Wild Horses and Burros Act. It is likely that other State cases concerning this decision will be tried. In Alaska, the major environmental protection legislation of 1976 was A.S. 46.03.760. This law provides for civil action for pollution damages. Fines have been increased and violators are made to pay the same costs they could have paid for measures to protect the environment. This method of balancing costs for environmental protection is called the Connecticut Plan. Liability for restoration has not been tested much in Alaska. Alaska State authority for enforcement of environmental and related laws remains as discussed at the Surface Protection Seminar in 1976.

After the Wild Horses and Burro decision that Jack [Allen] mentioned was issued, I attended a conference of The National Association of Attorneys General, Committee on the

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Environment. The Assistant Attorney General of New Mexico got up, and after the booing stopped (because we attorneys are jealous of our jurisdiction), she apologized for that decision and gave us some background on it. It was interesting to note that the case was argued on behalf of the State of New Mexico by some special assistant attorneys general. These were private practitioners who were appointed to argue this case. As the speaker described it, they did a lousy job. They failed to cite some important cases to the Supreme Court and, as a result, it will probably take 10 or 15 years to straighten out the situation, as far as the National Association of Assistant Attorneys General dealing with environmental matters is concerned!

There was a considerable amount of discussion among the various assistant attorneys general as to how to handle that case, and there was a big split. Many of the assistant attorneys general at the conference felt, "So what? If the Federal Government will do its job properly, what do we care if they are the ones to enforce the environmental laws, protect the surface environment, and keep the water clean? What do we care whether we or they do the job?"

Other attorneys general there said, "We care plenty! We don't want to go to work for the Federal Government; the Federal Government doesn't want us to work for them. We're going to be out of a job if we don't get this situation straightened out."

When we left, our "instructions" were to keep our eyes and ears open for the right case to brief properly and perhaps to try to get what half the group felt was a needed clarification of the Supreme Court's decision or a reversal.

I imagine that many Federal attorneys are saying, "Great, we don't want to do this either." It's a big conflict. There are 50 States, and every time we have a problem in one State we're going to have 50 different cases. That gets to be a headache when the Supreme Court has already decided the issue.

So, we are keeping our eyes open for the right decision. One individual at the conference wrote literally 500 pages of information about that case. He discussed how it should have been decided, why the Supreme Court was wrong, what cases were not cited to the Supreme Court, and how future cases brought by a State should be handled.

I don't know what is going to happen. I was not sent to the follow-up conference this year, but I am waiting to see what kinds of remarks were made there. I understand that a couple of cases are wending their way up through the Federal circuit. Various States are going to be asked to come in and be amicus curie (friends of the Court) and file briefs to help "take away" from the Federal Government jurisdiction that many States felt the Feds didn't have in the first place!

As for the Organic Act and its effect on Mining Laws, discussion is interesting to the State of Alaska. People who wish to mine on State lands now must obtain a State lease. Our method of protecting the surface environment is through stipulations in those State leases. I imagine that in time, these stipulations will become more stringent, in terms of protecting the State environment.

The year 1976 was a major turning point for environmental protection in Alaska where the State perspective is concerned because of the enactment of A.S. 46.03.760, the Alaska statute that provides for civil action for pollution damages. I think it demonstrates a trend that many States are taking. It's called the Connecticut approach (obviously, because Tennessee did it). We have strengthened our penalties here in the State over the past year from $1,000 to $25,000 fines for violation of State statutes, leases, and other matters that deal with the environment.

We also have a system whereby an individual can never be rewarded for degrading the environment. In many instances and certainly before last year, if you damaged the environment--the surface of the land--in the State of Alaska you would go to court, perhaps get civil penalties; you might get hit with criminal penalties and there'd be a $1,000 or $2,000 fine spread over a period of time. That would be it, and the individual who didn't take the proper measures to protect the environment could walk away with a windfall. Although he paid a small fine, it certainly was, in many instances, a lot less than he would have had to spend to protect the environment properly.

Today, we have a system whereby the Attorney General's Office and the Department of Environmental Conservation go after individuals who, for example, degrade the environment by placing oil on the land. First, we assess criminal penalties. It is the policy of the State of Alaska and has been for the past year to get criminal penalties for

environmental degradation. (And it's not always easy to do, I might add.) In addition, we go for civil penalties. Under what is known as the Connecticut Plan, we approach each individual circumstance and determine how much money was saved by violating the statutes. Examples are not putting in proper treatment systems or not following a lease. In addition to the $25,000 civil penalty which we may collect, we attempt to collect that amount of money which the individual saved by not protecting the environment properly. In this way the violator pays the same costs as the individual who obeys the laws. It is not meant to be punitive, but it is meant to bring everybody up to the same level. If you don't protect the environment because you want to save money or do something quickly, in the long run, after the cases get through the court, you will pay the same amount of money that you would have invested in facilities to protect the environment.

I think that's the big change in Alaska from the State perspective. While it is interesting to see the enlargement of the Federal jurisdiction, as far as we are concerned the big change in the State of Alaska is the policy that we have adopted that people are not going to be punished by simply being thrown in jail! We're attempting to make it economically impractical for an individual, company, corporation, or other group to pollute the environment because we require them to make payments into the State Treasury equal to the amount it would have taken to do it right in the first place.

In addition to that, we impose liability for restoration, something that really has not been tested very much in the State.

Except for those changes, the State of Alaska authority for enforcement of our environmental laws and related laws is the same as I discussed last year. The statutes are the same and the emphasis is still on lease stipulations and enforcement of the laws we have on the books through the procedures that I outlined last year.

The North Slope Borough
Proposed Environmental Protection Plan

Jon Buchholdt*

ABSTRACT
A proposed Statement of the Environmental Protection Policy of the North Slope Borough was prepared by the Borough Director of Conservation and Environmental Security at the request of the Borough Assembly President. It is being reviewed by the Borough Assembly and Planning Commission. Included in the statement are background, outlining need for the policy and progress toward its formation, a policy statement, and strategy for implementing the policy. Four points to the strategy are: Arctic Coastal Zone Management; Surface Disturbance Management; Game Management; and Arctic Environmental Research Management.

[Mr. Buchholdt read the following Statement of the Environmental Protection Policy of the North Slope Borough. It was prepared at the request of Oliver Leavitt, who is President of the Borough Assembly, and submitted to Mayor Eben Hopson by Billy Neakok, Borough Director of Conservation and Environmental Security.]

*Mr. Buchholdt is Assistant to Mayor Eben Hopson, North Slope Borough

One of the reasons for the organization of the North Slope Borough in 1972 was our need to protect our land against the harmful results of arctic energy fuel development. We did so with the full knowledge that our Arctic Slope Regional Corporation would become actively involved in the oil and gas business.

Organizing an arctic regional home-rule government from scratch has been demanding upon our community, but its complexities have not distracted us from the task of defending the environmental security of our land and people.

The evolution of the Borough's environmental protection policy began in the spring of 1960, when the people of Barrow engaged in the peaceful direct-action demonstration against the enforcement of Migratory Bird Treaty's ban on our subsistence duck hunting. This incident, the Barrow "Duck-In," reflected popular mood that resulted in our region's leadership in the Alaska Native Land Claims movement in the 1960's, and in the development of regional government in the 1970's. While we were politically powerless during the initial exploration and development of the Prudhoe Bay field, Borough organization enabled us to deal with further development.

Perhaps the first significant event in the evolution of Borough environmental protection policy was the Borough's land selections at Prudhoe Bay. Under State law, our Borough government is entitled to select up to 10 percent of State-owned lands within our jurisdiction. Our first selections in 1973 under this entitlement were made to enable our government to control the use of gravel at Prudhoe Bay. It is our policy to regard gravel as surface estate and as a critically important environmental factor. Unfortunately, this initial effort to assert local control over the environment was opposed by the State of Alaska and resulted in litigation that continues.

In 1974, we were presented with national decisions to conduct Arctic Outer Continental Shelf (OCS) lease sales and speed up the exploration and development of Naval Petroleum Reserve No. 4 (NPR-4). We began hearing from the Inuvialuit about Canadian offshore oil and gas operations in the Beaufort Sea. We interceded in the Union Oil East Harrison Bay ice island exploration project and arranged for Union Oil engineers to come to Barrow to explain this project to the Borough's staff, Planning Commission, and Assembly.

In 1975 the Borough interceded in the enactment of national Naval petroleum reserves legislation that transferred NPR-4 (now NPR-A) to the civilian control of the Department of the Interior. We caused language to be included in this legislation that established the NPR-A Task Force to enable equal participation of the Borough and Arctic Slope Regional Corporation in comprehensive NPR-A land use planning.

The Borough's successful Washington, D. C. NPR-4 lobby laid the foundation for the decision to establish a full-time Washington, D. C. Legislative Liaison program earlier this year.

While we began closely monitoring plans for offshore operations in the U. S. Beaufort, we continued to hear disturbing reports of Canadian Beaufort Sea projects and in the summer of 1975, we made a decision to establish good communications with our people in Canada and Greenland in order to keep informed of all Arctic offshore operations. This led to plans to host a conference of our community leaders from Canada and Greenland.

In January 1976, you were asked by the Inuvialuit of Inuvik, Northwest Territories, to intercede with the Canadian Government against plans to permit the oil industry to begin Arctic OCS operations in the Canadian Beaufort Sea, and subsequent work led the Borough to adopt the policy that Canadian Beaufort Sea OCS operations were of direct concern to the people of the Borough.

In March 1976, the Borough conducted a preconference planning meeting attended by Inupiat land claims leaders from Canada and Greenland. We met to plan an agenda for the first Inuit Circumpolar Conference (I.C.C.) that was scheduled for November. This conference was later rescheduled for the week of June 13, 1977.

In June 1976, the Canadian cabinet granted final approval of the first Beaufort Sea OCS explorations and the Borough undertook to bring these operations to national attention. Because information had been circulated that these operations were approved after a five-year environmental impact assessment program, the Canadian Beaufort Sea study resulted in scientific recommendations that final approval be withheld pending the development of improved and proven Arctic OCS technology. Our Borough's policy was to oppose all Arctic OCS operations until safe and responsible extraction technology could be designed and tested. At the same time, it was decided to support State efforts to consolidate State and Federal near-shore explorations as a safe first step in U. S. Beaufort offshore operations.

The Borough's Planning Department began to document traditional/historical use of Beaufort coastal zone lands that might be impacted by offshore and NPR-A operations with a view to eventual designation of industrial development and historic use zones.

In December 1976, the Borough decided to initiate an Arctic Coastal Zone Management Program (CZM) as an interdepartmental project of the Mayor's office and the Planning Department. The I.C.C. was viewed as a CZM activity aimed at organizing international CZM cooperation able to deal with the Beaufort Sea as a single ecological system in which all offshore operations would be held to a single set of rules.

In the summer of 1976, it became clear to the Borough that the Arctic Gas pipeline route had strong national political support in both the U. S. and Canada, and the Mackenzie Valley route became an environmental protection and CZM problem.

Borough sensitivity to the fact that pipelines may contribute to environmental problems was heightened by the 1976 Western Arctic caribou herd crisis. Widespread worry about the impact of trans-Alaska oil pipeline construction upon normal caribou herd migration appeared to have been justified when the State suddenly placed sharp restrictions upon subsistence caribou hunting, citing a sudden reduction in the size of the herd. The Borough responded to the crisis by establishing, with the help of the Arctic Slope Regional Corporation, a Borough Game Management Committee, and we began to plan improved game management as an important step in the evolution of our environmental protection policy.

In February you made the decision to take an important step to secure Assembly approval of the creation of the Borough's new Department of Conservation and Environmental Security. Concurrently, you also established the Borough's new Washington, D. C. Legislative Liaison and engaged a highly regarded, politically knowledgeable Washington, D. C. law firm to assist in the development of sound national Arctic policies.

POLICY STATEMENT

It is the policy of the North Slope Borough to recognize the inevitable development of Arctic energy and mineral reserves and the threats to our environmental security posed by this development. We seek to avoid harmful impact upon its citizens, families, and communities resulting from this development. We feel with good cooperation between government and industry, our land can yield its subsurface wealth with tolerable disturbance to our people and our land.

Our greatest concern is caused by Arctic offshore operations. We know of no proven technology through which oil can be safely taken from under the ice that covers the Arctic outer continental shelf. The Borough is anxious to actively cooperate in Arctic offshore technology, research, and development.

Cooperation is the key to the Borough's environmental protection policy. We believe this cooperation must be circumpolar in scope and character, and it must be led by the five Arctic coastal nations. Our most immediate need for this level of cooperation relates to Beaufort OCS operations begun by the oil and gas industry in the Canadian Beaufort. We look for the organization of a single Arctic offshore working agreement between Canada and the U. S.; a single trilateral

coastal zone management system; trilateral because there is a need for a strong Arctic energy partnership between the United States, Canada, and the Circumpolar Inupiat community. We seek the security assured by one law in the Arctic, one Law of the Sea.

Within our jurisdiction, we seek sufficient control over surface-disturbing development to enable protection of the many traditional use values of our land. To gain this control, we will negotiate where we can, but legislate where we must.

Our Borough environmental policy recognizes our responsibilities of public stewardship over the national Arctic values of our land. Thus, it is our policy to guard against permanent immigration to the Arctic. We are opposed to the creation of permanent oil field communities and regard Arctic population growth to be potentially our greatest environmental security problem. Accordingly, we oppose public use of the Fairbanks-Prudhoe oil pipeline haul road and other such permanent public access to the Arctic.

STRATEGY

Introduction

The [Department of Community Environmental Security] DCES will use a four-point strategy to carry out the Borough's environmental protection policy: Arctic Coastal Zone Management in cooperation with State, local, and Canadian governments; Surface Disturbance Management aimed at the protection of environment and conservation of traditional land use values; Game Management to improve Arctic game management through the use of modern technology and traditional hunting skills; and Arctic Environmental Research Management to lead and organize a sustaining program of national and international scientific research and cooperation able to deal with the Arctic as a whole from our own point of view.

1. Arctic Coastal Zone Management

Environmental security problems posed by Arctic offshore operations will be handled by the Arctic Coastal Zone Management Program (CZM). International cooperation will be essential to successful Arctic Coastal Zone Management. This cooperation must include strong industrial participation. As a result, our Arctic Coastal Zone Management Program will be operated as an international Arctic regional program.

Because of the international character of environmental security problems posed by Arctic offshore operations, our Arctic Coastal Zone Management Program will be operated as an international program.

As a means to organizing international cooperation necessary to our environmental security, the Borough has organized the First Inuit Circumpolar Conference with the hope that the Inupiat Circumpolar Assembly will be organized as an ongoing federation of all regional Inupiat communities in North America. The Inupiat Circumpolar Assembly would negotiate with the governments of Greenland, Canada, and the U. S. for agreements necessary for successful Arctic Coast Zone Management and the protection of international Arctic environmental security.

The organized participation of the circumpolar Inupiat community in Arctic Coastal Zone Management is necessary for safe and successful Arctic offshore operations, so our Borough's own CZM program will be organized as a prototype model designed for possible use by our people in Canada and Greenland as they develop home-rule government.

2. Surface Disturbance Management

Surface Disturbance Management will be aimed at the protection of traditional, cultural, and existing land-use values in the face of the development of oil, gas, coal, and mineral reserves within the Borough. When fully operational, our Surface Disturbance Management Program will enable Borough planners and field workers to work with each exploration or development project to insure minimum surface disturbance, maximum value conservation, and environmental security. Surface Disturbance Management will necessarily require close cooperation with State and Federal agencies to avoid duplication of effort and to insure good enforcement of State and Federal regulations governing Arctic Slope resource development.

Working closely with the Planning Department and with the Arctic Slope Regional Corporation, we will begin to develop a computerized Land Use Management Information System for effective site-specific management and protection of our land. This information will include oral, as well as documented historic use; animal census; history of surface disturbances; estimated resource values; capital improvements; etc., for each section of land within the North Slope Borough.

3. Game Management

Even though the State of Alaska is charged with the exclusive responsibility for game management and it is not a power exercised by the North Slope Borough, the DCES will build a complete Boroughwide Game Management program to supplement, and cooperate with, Federal and State game management programs. The Borough's Game Management Program will join professional with traditional game management techniques to improve our management of caribou, for instance. Joining with the Inuvialuit of the Canadian Western Arctic, we will maintain close surveillance of the entire Western Arctic caribou herd. Through all of this we will be able to replace management theory with documented

knowledge of the herd's size, locations, ages, and general health. This knowledge will enable more rational caribou management than is possible today. We hope to pioneer the role of local government in North American Arctic game management. And, our Game Management Program will enable our best hunters to earn money by using and improving their hunting knowledge and skills upon which our game management will be based.

The decriminalization of Arctic subsistence hunting of migratory birds will be pursued as part of our Game Management Program. We will work to provide for subsistence hunting in the U. S./ Canadian Migratory Birds Treaty, just as such provision was made in the recently signed U. S./U.S.S.R Migratory Birds Treaty.

Through its Game Management Program, the Borough will cooperate with the work of the International Whaling Commission to conserve stocks of our Bowhead Whale and the other whale species used by our people.

4. <u>Arctic Environmental Research Management</u>

The DCES will undertake to organize an Arctic Environmental Research Management agenda necessary for the protection of our International Arctic environmental security. Among the objectives of this agenda would be the formation of:

a. Minimum criteria for acceptable environmental impact statements.

b. Ongoing analysis of environmental safety of Arctic energy industrial technology.

c. Ongoing research and surveillance of the developing Law of the Sea of the Arctic.

d. Game biology and management research.

e. Organization of international Arctic scientific research programs in which modern scientific method is joined with the memory of Inupiat oral history, the store of empirical knowledge verbally transmitted by the Inupiat from generation to generation.

f. Development of the "energy park" concept as an option for land classification and management within the Borough. The energy park concept would result in a thorough assessment of subsurface values, and controlled development for the purpose of safe resource extraction and the ultimate classification of the lands as a single Arctic coastal wildlife refuge and an international environmental security zone.

Surface Protection Requirements on State Lands

William H. Copeland*

ABSTRACT
The State has established surface protection policies and requirements as oil and gas development progressed on State-owned lands on the Arctic Slope. Regulation is accomplished by permit under oil and gas leases and the State's Miscellaneous Land-Use Regulations. Activity on tundra is controlled seasonally to reduce surface damage. Ice and snow roads and sea ice routes are used for winter travel, and Rolligons for all-season travel. Gravel extraction and water use are other activities with which the State is concerned. Interagency cooperation has improved and the State is working with industry for coordination and planning.

Essentially, there are three major blocks of land on the Arctic Slope, the NPR-A, State lands, and the Arctic National Wildlife Range. The block of land between NPR-A and the Wildlife Range is owned by the State and is currently under oil and gas development. Over the years, through experience, the Department of Natural Resources has established a good number of guidelines and directions as policies and requirements for surface protection on the

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State land portion. We should be able to pass what we have learned on to managers of other areas that may experience oil and gas development on the Arctic Slope.

Basically, the department's authority for regulation of oil and gas and related activities on the Arctic Slope is through two avenues. One is within the oil and gas leases themselves by the requirement for lease operation permits. Operation plans submitted by industry are reviewed and stipulations issued before exploration or development work begins. The other is with the State's Miscellaneous Land-Use Regulations, which provide for surface protection where other permits or leases do not otherwise provide for this protection. Examples are transportation to and from a given point and activities not related to a particular oil and gas lease that occur across several or that transect different permit areas, such as seismic exploration.

Under these regulations, the department can designate lands for "special use," as we have done on all lands under State ownership on the Arctic Slope. Under the special-use lands designation, we can specify those types of activities that require a permit. All oil- and gas-related exploration, development, and seismic activities require a permit from the State. This has been in effect for several years. Industry is aware of it and the permit process is going rather well.

I will divide some of our policies on the Arctic Slope for development into various sections. For example, take production drilling versus exploratory drilling. The requirements for environmental protection of surface alteration from the exploratory drilling developments are considerably different from those for production drilling, such as that in the Prudhoe Bay area. Under the oil and gas leases, industry has a certain amount of surface use afforded to it. To minimize the alteration impacts on the land, the department requires justification of the various roads, pads, and other facilities and confines them to oil- and gas-related use.

On tundra, activity is controlled seasonally. At times industry's activities can occur on the frozen and snow-covered tundra and at other times they are confined to existing roads and pads. Any gravel operations, such as gravel filling, must be done ahead of the vehicles rather than run the vehicles on tundra. For production drilling, rather extensive and permanent roadwork and gravel pads are allowed. We take a more stringent view toward exploratory

drilling, however, and do not allow permanent facilities other than the gravel pad for drilling itself. We have confined the oil and gas exploratory drilling to just the pad and don't allow permanent airstrips and access roads.

We encourage industries, and it is their general practice, to conduct exploratory drilling activities during the winter months. Ideally, they start soon after freeze-up if there is adequate snow coverage on the tundra or, depending on the location of the well, the sea ice if frozen sufficiently so they can travel on it. If a drilling operation can get started at the beginning of the season and complete their operations by March, in other words, before breakup, the situation is ideal. If during the course of the drilling, the operators encounter problems or a blowout, they generally have about two months left, April and May, to remedy the problem. Large numbers of vehicles and equipment may have to be hauled in to remedy problems. If drilling continued normally until close to May, or breakup, and the problem remained, remedial activities might have to be continued into the breakup season, causing heavier surface damage.

If a blowout occurred, we certainly wouldn't prevent equipment from moving in to correct it. The blowout would cause worse environmental damage than the vehicle movement. Restoration work, however, would have to be done to correct damage from on-tundra vehicle movement if remedial activities had to take place after breakup.

While we encourage industry to complete exploratory drilling operations by March, drilling is not restricted to the winter months. Industry can drill in the summer if they wish but they must use air support or overland vehicles such as Rolligons.

After several years of observing tundra travel and exploratory drilling, we are somewhat relaxed in our concern for the effects on the tundra itself. In the past, we demanded that there be a gravel pad for all exploratory drilling operations. Most exploratory holes are dry holes. When industry workers abandoned the dry holes, they moved everything off. Nothing remained except the required pad--a gravel monument on the tundra.

Today our observations show that the tundra take greater abuse initially, and if not disturbed too badly, will recover. We are now willing to allow exploratory drilling operations to be conducted during the winter

months without a gravel pad if snow and ice conditions are adequate for snow pad construction. Some restoration work usually is required on the tundra following the drilling operation. Within two or three summer seasons, if restoration has been done properly, a layman traveling over the site by air should see no trace of the drilling operation. The tundra is a living thing and will heal itself if not disturbed too badly. We may leave the choice to industry, but we would be willing to accept this method of operation if industry tried it. A disadvantage is that if they have downhole problems or if they don't complete the drilling in one season, they must move everything off the tundra before breakup. So we're flexible; we're willing to allow the exploratory operation without a gravel pad.

Concerning tundra travel, under the Miscellaneous Land-Use Regulations and the Special-Use Lands designation, the department has the authority to close the tundra to surface activity and travel after breakup and during the summer months. Operations that are ongoing on the Arctic Slope right now, for instance, are subject to a 72-hour notification to cease their operations on the tundra and get to the nearest road or pads. We monitor temperatures daily and make more frequent field inspections as breakup approaches. Virtually no activity is allowed on the tundra for the first month after breakup. Breakup occurs most often toward the end of May. The tundra is very wet as it thaws, although only a few inches thaw. Even the Rolligon-type vehicles would damage the tundra severely then.

After the thaw-down, dry-out period, Rolligon vehicles are allowed on the tundra with stipulations governing the various type of tundra conditions they travel over during July, August, and September. We review each activity and each route. In some tundra areas, a loaded Bechtel-type Rolligon can pass several hundred times without causing any significant damage. If damage is caused, the tundra generally will recover within three years. In other places, the Rolligon cannot go. For example, the tundra near the coastline, containing many lakes and wet vegetation, has several areas that are too wet and soft to support the weight of a Rolligon-type vehicle. In these areas, Rolligon travel can cause considerable surface disturbance as well as cause the vehicle to get stuck. Judicious use of these vehicles in those areas during summer months is required.

We also have observed the performance of two types of Rolligons. There is a distinct, significant difference between the Houston-type and the Bechtel-type Rolligons. We

place more restrictions on the Houston Rolligon because it has axle drive rather than roller drive. It also has cleated tires, which cause quite a bit of damage when they spin. The Bechtel Rolligon has roller drive and smooth tires. When it gets stuck, the first thing that spins is the roller rather than the tire, causing considerably less tundra disturbance than the Houston Rolligon.

In winter operations almost any vehicle can be used, depending on the type of tundra surface preparation. The tundra generally is ready for vehicular activity around November 1. By then there generally has been adequate freezing of the tundra as well as adequate snow cover. These are the two conditions we look for. The seismic activities with Nodwell-type vehicles can then begin. Before that if temperatures are low enough ice roads could be built, but generally are quite expensive when not enough snow is available.

After snow cover is adequate it is common practice to build ice roads for relatively short distances. Ice roads longer than 10 to 15 miles are large endeavors. Incidentally, we don't tell industry how to build ice roads; they know how. We just look for the results. An ice road is to be built and maintained adequately to protect the tundra. When field inspecting ice roads it's fairly easy to see when the tundra is not protected well enough. When viewed from the air, dark patches in an otherwise white road surface indicate inadequate protection. A well-built ice road can support almost any type of wheeled or tracked vehicle.

If major equipment must be moved across the tundra and no ice road is built, we become a little more concerned with the snow depths and the types of vehicles or sleds that are used. Sleds that have narrow runners can cause significant rutting in the tundra. The ruts show up the following spring as little streams. Conversely, when sleds with wide runners are used, damage can be caused by the great amount of static friction from the tractor spinning its grousers as it tries to move the sled. So, there's a happy medium to watch for on runners.

Rolligons are used extensively throughout the winter because they are very fast compared to other types of tundra vehicles. If they are run on regular haul routes, a decent snow road may build up from repeated packing of snow after driftings. In some cases, the road is adequate with little

ice or water application. Sleds or even trailers with wheels can be pulled safely across these roads. That's something to keep in mind during developments in PET-4.

When winter operations are proposed to take place near the coastline, an alternate surface travel route to consider is over the sea ice. Only after January 1 is the use of the sea ice a satisfactory alternative to overland travel. It is approximately this date when the ice is frozen enough to be considered safe for heavy equipment travel. In any event, the use of sea ice routes should be presented as an alternate to overland travel and not the only choice. Because of the dangers of sea ice, such as pressure ridges, leads, and thin ice off river deltas, operators should be allowed to evaluate the risks and decide for themselves if they wish to travel over it as an alternative route. It is desirable from a surface protection aspect but involves greater risk than overland travel.

We have found that if operators avoid building ice roads in successive years on the same route they prevent a lot of tundra damage. Evidence of use is visible for at least two years after a single year's use. We have sometimes asked companies to move their ice road 100 feet or so to one side or the other of the previous year's route to prevent the repeated impact on the tundra.

On exploratory drilling pads, we allow ice and snow airstrips, either Herc or Otter-size strips.

Other areas of concern in the Arctic involve gravel extraction. This occurs primarily from gravel bars in rivers. We try to keep activities out of the active river channels.

Water use also is rather important in the Prudhoe Bay development area where significant amounts of water are used. This causes an impact on another resource, the fisheries. Industry is responding quite well to this problem by developing water reservoirs in several locations where they extract gravel. They fill these during the summer when water is everywhere, and significantly reduce the impact on streams during winter.

Interagency coordination is greatly improved and is working very well on the Arctic Slope. The Department of Natural Resources will carry many of the Fish and Game and Environmental Conservation Department stipulations where they would not otherwise have specific authority. For

instance, I am sure that under Title 16, within the rivers Fish and Game can carry its own stipulations. But in situations regarding upland game habitat, stipulations addressing concern for this may have to be addressed through land-use permits issued by the Department of Natural Resources. The same interagency support applies to Environmental Conservation stipulations. Generally, whenever a drilling operation is about to begin, these agencies meet jointly with the industry and propose procedures before the actual permit is issued.

Coordination with industry and involving industry in planning future use, policies, activities, and methods has been good. Industry has been willing to suggest new ideas and has responded to many of the problems fairly well.

I think we are smoothing our act out in the Prudhoe area quite well. Overall, we are observing a commitment the department has made by issuing oil and gas leases to industry. We're committed to oil and gas development and at the same time, we are committed to minimizing the impact. We hope to regulate activity so that in 20 to 40 years, we still will have the other resource values that were there when development began.

One last note: we are extremely interested in any ongoing research, either by industry, government, or institutions, regarding new methods and new activities on the Arctic Slope.

Surface Protection Requirements on the Arctic National Wildlife Range

Marvin Plenert*

ABSTRACT
The National Wildlife Refuge System is comprised of more than 380 units scattered among 50 States. It encompasses about 34 million acres. It was established to insure protection and preservation of wild lands and wildlife resources to meet people's needs for consumptive and nonconsumptive uses. Management is by Congressional directive. The refuges are multiple-value rather than multiple-use lands. They are closed to all activities unless specifically opened by permit. Each permit request is considered separately from others and activities are regulated by stipulation. New funds for Arctic National Wildlife Range management will enable the Fish and Wildlife Service to station additional personnel on the Range, gather resource and use data, and work more closely with persons using the Range lands.

Before I discuss the Arctic Range, I wish to characterize the National Wildlife Refuge System as a whole. The Arctic Range is just one of more than 380 units in the National Wildlife Refuge System. The units are scattered throughout the 50 States and total about 34 million acres.

*Mr. Plenert was Alaska Refuge Supervisor, Division of Refuges, U. S. Fish and Wildlife Service, Anchorage, Alaska.

The National Wildlife Refuge System is probably the most widely distributed public land resource in the United States. It deals exclusively with wildlife management and preservation of the habitat. The refuge system was established in 1903 to insure protection and preservation of wildlands and wildlife resources to meet people's needs for observation and for other uses.

Each refuge is established either by Executive Order, Public Land Order, or through authorized purchase. In the Lower 48, refuges are established for specific reasons, and each one is treated separately in terms of issuing permits for noncomforming public use.

For more than 70 years, Congress has repeatedly given directions and confirmed through laws and mandates the administrative measures we deal with on a daily basis. To name a few, there are the Migratory Bird Conservation Act, Endangered Species Act, Antiquities Act, Refuge-Recreation Act, the National Historic Preservation Act, National Environmental Protection Act (NEPA), and the National Wildlife Refuge System Act, which is presently the Organic Act of the refuge system. In 1975 an amendment to that Act was passed, which required Congressional concurrence to dispose of any lands from the National Wildlife Refuge System.

National Wildlife Refuges are multiple-value lands rather than multiple-use lands. Although a variety of uses may be accommodated on them, several mandates have been clearly enunciated by the Congressional directives from which the refuge system operates. They are as follows:

> "1. The primary involvement use shall be for the welfare of wildlife and the habitat, and all other uses must be compatible with the major purpose for which such areas were established; 2. No uses may be permitted that are in conflict with the dominant use or objective of the Refuge; and 3. Special efforts shall be maintained to preserve and protect the natural beauty of each area, and the Fish and Wildlife Service, as the managing agency, shall issue stipulations to prevent damage to wildlife haibtat."

The basic policy for these regulations comes from Title 50, Code of Federal Regulations. Basically, the entire Wildlife Refuge System is closed to all activities unless specifically open. Anything that is to be allowed on

a Wildlife Refuge must be fully evaluated, and any permit must contain stipulations necessary to protect the habitat and minimize destruction. The authority to monitor and enforce regulations is delegated to the refuge manager in charge.

Now I'll touch on some of the responsibilities the Fish and Wildlife Service has for the Arctic Range. The Public Land Order that established the Arctic Range in part states that the primary purpose was to preserve scenic, wildlife, wilderness, and recreational values.

A review of the extensive and detailed files demonstrates that exhaustive efforts were made by Alaskans and people outside of Alaska and the United States over a 10-year period to establish the area as a Wildlife Range. During this 10-year period, many sportsmen's groups, conservation agencies, and civic groups were involved and supported its establishment. We feel there is no doubt that the Arctic National Wildlife Range is one of the major national preserves in the United States. The values there are so great that some have said it ranks among the great landscapes of the world. I read in the paper last night that someone compared crossing the Arctic with a 48-inch pipeline and a haul road to slashing the face of the Mona Lisa with a razor blade.

You can see that requests for permits to conduct scientific investigations on the Arctic Range, for whatever reason, must receive special screening. Adequate stipulations must be applied and attached to the permit to insure the proper protection. We handle every permit request on its own individual merits, no matter what Refuge it concerns. It amounts to establishing orders on the particular land we are dealing with.

Some things we look at are the type of operation planned, location within the refuge, transportation required to conduct the operation, what kind of aircraft will be used--fixed-wing or helicopter. The time of the year is important, as are wildlife movements in the area, status of the particular species of wildlife, the equipment needs, and number of people involved in the operation. All of these are considered before a permit is issued or denied.

With the recent emphasis on offshore oil development in Alaska, we have been requested to issue permits to explore surface geology. Each of these requests is considered on its own merits.

I went through the files today and selected an example of conditions attached to just one permit issued for a geological or surface study. These are the conditions:

"Close liaison between the [industry] representatives and the Refuge Manager will be maintained for the purpose of minimizing disturbance to wildlife in sensitive areas or during critical times to avoid disturbance to recreational users."

Close liaison is important in dealing with anyone who comes on the Wildlife Refuge for whatever purpose. You lay out the ground rules for playing the game, because if they don't know what the rules are and don't know what is expected, it becomes more difficult.

"The permittee will submit a detailed map to the Refuge Manager showing the study requested; permittee will post a security bond for negligence; permittee will designate a local agent employed by the permittee, upon whom may be served written orders or notices respecting all matters concerning this permit."

It's important to know who you're dealing with--everybody involved, including the key person--before you issue a permit so that if any problems arise or changes occur you can alter the study or do whatever is needed.

"This permit authorizes the use of helicopters. The use of surface travel vehicles including air-cushion machines is not permitted. Construction of airstrips not permitted. Temporary camp locations must be approved by the Refuge Manager.

"The permittee shall observe the following land-use rules: All refuse, fuel, food, tents, debris, etc. will be removed from the range. Garbage may not be buried. Clearing or cutting of vegetation for camps or aircraft landing areas is not permitted. Big game hunting or fishing by the permittee or its agents is not permitted.

"Permittee must comply with the Antiquities Act. Permittee must keep the Refuge Manager advised at all times on the color, kind, and number of helicopters used on the Wildlife Range. All fuel containers and other containers used must be marked with the permittee's name. As soon as practical, the permittee will furnish the Refuge Manager with a report

of activities, listing the areas worked, campsites occupied, archeological sites, geographic and topographic points of interest, and wildlife observed."

The conditions go on but I won't read more.

The period of time the permit covers is important, depending upon the refuge. The period of time that certain aircraft may be used also is regulated. As an example, if nesting cliffs or seabirds are involved, it's very important to limit the time to disturbance by aircraft.

In summary, the Fish and Wildlife Service has by various mandates an operational mechanism to rigidly protect habitat and resources entrusted to us by the American people. We may need more, but this is what we have and we must make the best of it.

As for what lies ahead for the Arctic Wildlife Range, we are fortunate to have received sufficient funding. We're increasing our staff at our Fairbanks headquarters and will man permanent field stations in the future. This year we have doubled the staff, and next year may double it again. We are going to make every effort possible to collect the wildlife resource data, public use data, and whatever other data are necessary on which to base proper and sound wildlife management. We are going to station one assistant manager in Kaktovik in midsummer, and next year we're also going to assign an assistant manager to Arctic Village. We'll try to work more closely with the people who use the area. It's very difficult to manage an area as large as the Arctic Range from four or five hundred miles away in Fairbanks. Some major changes are on the horizon, however, that will enable us to do a better job of managing the Arctic Range resources.

Session 2 Discussion

MR. CARL JEGLUM: I'm Carl Jeglum from Fairbanks. I'm wondering how you arrive at the size of the Wildlife Department?

MR. PLENERT: I think it's kind of arbitrary. It may vary from 10,000 to 50,000 or 100,000, depending on the operation requested.

MR. JEGLUM: Do you have some guidelines?

MR. PLENERT: Yes, from the Solicitor's Office, or we have received them from there in the past.

MR. WILLIAM MITCHELL: Mr. Copeland, I think you went into the policy of gravel pad distribution. It wasn't clear to me.

MR. COPELAND: With respect to exploratory drilling or production drilling?

MR. MITCHELL: Exploratory drilling.

MR. COPELAND: For exploratory drilling we currently allow a gravel pad for the drilling pad itself, nothing else, as far as a permanent structure. The State holds the title to the gravel, so that in the event another exploratory drilling operation takes place within a reasonable

hauling distance, the next company in may pick up that gravel pad and use it again in another place. We are willing to allow a drilling operation without a gravel pad if it can be shown that this can be done safely.

MR. RICHARD LeDOSQUET: You mentioned that you maintain title to the gravel. Do you sell the gravel initially?

MR. COPELAND: No, we "free-use" the gravel for exploratory drilling operations so that there is no question of who owns that gravel when we allow another company to pick it up.

MR. JOHN SANTORA: In your exploration program are you requiring closed mud system or are you allowing use of a reserve pit?

MR. COPELAND: It depends upon the location. If it's on the uplands it is a reserve pit situation; if it's on the offshore barrier islands where it is environmentally more critical, most of the operations go to a holding tank situation.

MR. SANTORA: One other question along that line: Has any well of the exploratory type been drilled in the upland barriers where the oil companies have tried the theory of not using a gravel pad, using the reserve pits, and then rehabilitating that area?

MR. COPELAND: Yes, that's happened. That was an initial practice on the Arctic Slope but they weren't very clean operations. It wasn't done properly and it really looked messy. The immediate reaction was to say, "No more of this. You go to gravel pads." But in observing those old operations, messy as they were, when they were cleaned up properly and restored properly they looked just fine.

MR. SANTORA: What you're saying then is that the short-term disturbances there when properly cleaned up, didn't show longer than five years.

MR. COPELAND: That's right.

MR. SANTORA: So that would be an acceptable measure of assessing, short term not long term.

MR. COPELAND: That's what I was trying to relate in our relaxing of the amount of damages acceptable on the tundra. After observation we know that on a short-term basis, the tundra can take a greater initial impact but it will restore, given a little help.

MR. SANTORA: This is the type of approach we'd like to take on PET-4 to be compatible with what the State is doing.

MR. COPELAND: It just has to be done carefully.

MR. JAMES COAN: Do you happen to have a copy of BLM stipulations/ regulations put on the operators around Prudhoe Bay that you're talking about?

MR. COPELAND: There's not exactly a standard list of stipulations. We do have a standard list regarding seismic operations. We also have the Miscellaneous Land-Use regulations; I have a copy of those. Otherwise, it's pretty much a site-specific list of stipulations regarding those various drilling operations, depending on where they are located, how long they are going to drill. It varies with that.

MR. JULES TILESTON: There has been quite a bit of discussion on aircraft use in the Arctic. What specifications, suggestions, or other sort of guide have you used or do you propose to use on the Arctic Game Range during the calving and to avoid musk ox harassment or sensitive periods? I'd be interested in both the flight elevations or kinds [of aircraft].

MR. PLENERT: The general rule of thumb is 2,000 feet minimum over sensitive areas, which depends on the type of aircraft and VFR conditions. If we're talking in terms of waterfowl staging areas or calving areas, the distance is greater, 10,000 feet or higher because of the sensitivity. Helicopters create more problems. Intensity varies with the time of the year. We've noticed that a helicopter sometimes can go very close without causing visible disturbance. At other times, it can be within a couple of miles and the critters just take off and scatter. So, to answer your question specifically, 2,000 feet minimum is stated by regulations. I don't know if this question has been sufficiently answered.

MR. SANTORA: Do you have the nesting density of waterfowl in the Reserve?

MR. PLENERT: Of course, it varies by species, but I think the last study was something like 50 pairs per square mile. That's on the Arctic Slope where the last intensive study was made. At first, aerial surveys revealed about five or six pairs per mile. These were supplemented by intensive ground studies where we covered swamps and walked through the sloughs. The increase in the number of pairs we found was really amazing. You just can't count them from aircraft; there's just no way, using conventional equipment. The Arctic Slope is also a large staging area for snow geese, as is the Solomons.

Surface Protection Issues Associated with Public Use of the Haul Road

Walter B. Parker

ABSTRACT
Decisions soon must be made on use of the Yukon to Prudhoe Bay haul road. Governor Hammond asked the Joint Federal-State Land Use Planning Commission for Alaska to provide a regional planning framework for decision making. Data are now being collected on which to base the framework. Surface protection is a major consideration, both on the road and on areas that will be affected by the road use. Management of the haul road lands is divided between State and Federal Governments. They share the problem of how to regulate all-terrain vehicle use that may radiate from the road. Study of ATV use history in the Denali area may provide some answers. Coordination among area resource managers is important if surface and other resource protection is to be achieved should the haul road be opened to public use.

Surface protection as it relates to the haul road is something that I've been interested in off and on for the past four years. I wish I could say that we are closer to having some of the conflicts resolved but we are not. There is little light on the horizon, however. We are reaching a time when some decisions are going to have to be made on haul road use so we will have to get out of the study phase and into the implementation phase, whether we're talking about implementation of plans or regulations.

The Land-Use Planning Commission was asked by Governor Hammond to coordinate Federal and State planning for Northern Alaska in order to provide a regional planning framework to which he can relate future decisions on the Yukon to Prudhoe Bay haul road. Decisions on the haul road will affect the planning objectives of many of you for Northern Alaska. Among these objectives is the surface protection of the areas immediately associated with the haul road. Another major problem is the effects of the utilization of the haul road on surface protection on the area of influence of the haul road. This area can be defined fairly broadly if you extrapolate all possible influences that can flow from the haul road in an essentially unregulated situation.

In order to provide a scientific base for development of surface protection regulations, the Commission has strongly supported the efforts of the Cold Regions Research and Engineering Laboratories (CRREL), the Alaska Department of Highways, the BLM, and other cooperators in obtaining baseline information on the haul road. With information from these and other scientific investigations, we should be able to make some pragmatic decisions on how best to achieve surface protection in the immediate vicinity of the haul road. Some information being sought is the extent of the dust shadow, the effect of the surface binding agents which will probably be used to mitigate dust, and the hydrology of the immediate area. These and other matters are of immediate concern for those who must maintain the road if the decision is to keep it open.

The problems on the immediate influence of the haul road are similar to road problems everywhere in Alaska. They can be solved as long as we keep up the relatively small efforts at data gathering that are under way at present. I think it is important that these efforts be kept ongoing. In the case of the haul road, it's probably better to spend a reasonable amount of money for research each year for a number of years than to try to concentrate the effort and a great deal of development money in a short period. I think we'll probably learn more from the first effort.

More important surface protection problems are likely to rise in connection with access from the haul road to the areas within reasonable range of it. Two major scenarios can be developed here. One relates to surface access from the haul road and the other to the influence of airborne operations, especially airstrips adjacent to the haul road.

I will not address the second of those because it affects the whole Arctic Slope and is well beyond the scope of what I wish to discuss today. It is probably the most important of the two, however, at least for fish and game managers.

From the Brooks Range north, the State and Federal surface land managers pretty well divide the haul road area between them. Whether regulated by Federal or State managers, the major problem is the same: how to regulate all-terrain vehicle use that can radiate from the haul road.

A subsidiary issue on fish and game and similar matters involves the ATV problem but does not relate directly to surface protection. But since it is a major area of influence we are going to have to concentrate on it somewhat.

We have a long history in Alaska of all-terrain vehicle use related to the existing highway system. The classic case is the Denali Highway and the hunting patterns that were established because the highway was opened at the same time that ATV use was developing in Alaska. We can examine the whole range of surface protection problems related to several generations of all-terrain vehicles, ranging from Weasels of the World War II vintage to the newest light-footprint vehicles.

Most important in this laboratory furnished by our experience is to examine the effects of changes in regulatory postures upon vehicle utilization. In that case, we're talking about the interaction between any land management regulations and vehicle use. Most of that time regulations didn't exist that were clearly in effect, and there was no statutory way in which ATV use could truly be restricted. But managers tried to affect vehicle use by regulatory postures, using existing Fish and Game regulations. We can examine how the Fish and Game regulations did influence vehicle utilization at certain periods of the year and possibly learn how they concentrated the ATV use or dispersed it.

Another reason to study surface protection experience along the Denali Highway is that such a wide range of ATV types has been used there. We can learn from the effects of different types of ATV's on certain areas, the geographical dispersion, whether vehicles concentrated on old Weasel trails, and what the dispersion patterns are for some of the newer vehicles.

Once the background has been established between various regulatory regimes and their effect on vehicle use, we should be able to make some judgments about what regulations will best achieve certain objectives in the haul road. Presently the five-mile-either-side-of-the-pipeline prohibition on hunting and fishing goes hand in hand with relatively unrestricted ATV use. I say "relatively unrestricted" in the sense that on the State lands you meet prohibitions against some uses and on the Federal lands you meet the regulations promulgated over the past few years. The five-mile restriction could force ATV users to travel at least five miles in either direction to conduct a legal hunt or to fish legally. This may achieve a desirable dispersal of hunting and fishing pressure but may also affect surface protection. That is the kind of trade-off land managers are going to have to look at if the haul road is opened to the public.

The difference between now and the future is in the ability of people who are not involved in any particular program on the Slope to get there. In essence, that's what most of the haul road discussion today is really about--access for people who are not involved in government programs and access for their ATV's.

The public would not accept the alternative of absolute restriction along 350 miles of the pipeline corridor. It is probable, therefore, that we will have to provide some areas for ATV use of the road if it is open, as well as areas where ATV's will be prohibited.

My experiences with such segregations indicate that these areas should be relatively large, so that those who want ATV recreational experience and those who want a non-motorized experience do not have to exist cheek-to-jowl. We may have to put them close together in the areas near urban centers (as we do in Turnagain Pass). Perhaps this will not be necessary along the haul road.

In many areas adjacent to the haul road, physiographic restrictions on ATV travel will be extreme. In others, unhindered mobility can be achieved, either in a winter or summer. ATV use will be extremely difficult to regulate in these areas, yet they will be the most attractive to ATV enthusiasts in the summer, fall, and spring. The usual regulatory method of channeling ATV's onto trails cannot be used in these areas. Such areas include most of the Arctic Slope in the winter and the Arctic Slope Foothills for most of the year except for midwinter. Those are the times of

the year when the heaviest ATV use would be expected if ATV's can get into the areas. The best way to protect these areas would be simply to maintain the haul road for public access only in summer, thus limiting the period of the year and the areas where ATV use would be permitted. Limiting road maintenance to summer would restrict some areas very quickly.

The relationship of ATV's to game management is most critical and requires the greatest attention. Firm regulations certainly can restrict or inhibit the ability of ATV's to inflict unreasonable surface damage. Regulations aimed at surface protection, therefore, should be thoroughly examined along with the regulations on game management.

Achieving successful surface protection requires that the periods during which the haul road will be maintained for public access be coordinated with surface protection regulations and the overall development of the subsurface estate in the areas influenced by the haul road. Without such coordination it will be impossible for any manager to achieve his goals in his particular area.

We can no longer afford situations where the Board of Game creates a walk-in hunting area while the land manager continues to permit all-terrain vehicle use in the same area. This has happened in the past. It has happened to many of you. You've been in a walk-in area, and somebody drove by on a trail bike. The regulations didn't apply to the trail biker because the area was not closed to ATV use and he wasn't hunting.

Access roads radiating from the haul road to any future mining location in the Brooks Range must be engineered to reflect the goals of fish and game managers to protect their interests. This is especially relevant to the protection of the marginal fisheries resources of the region. These are not impossible tasks and can be achieved easily, as long as each area manager makes a conscious and formal effort to coordinate with all others so we don't develop the syndrome of shifting burdens and causing impacts which we can't foresee from our own regulatory actions.

There is no new magic in the system. We have a good base of knowledge from which to go forward in insuring that ATV use is restricted by geographical areas, by the season, and by the density to those areas which can best support it. If we can achieve this, the surface protection problems of the haul road should be supportable.

Data Availability in Alaska

David M. Hickok*

ABSTRACT
We know a great deal about the Alaskan environment and resources, but perspective is needed to see knowledge in relation to issues and terms of reference from administrative and legal bodies. An obvious issue in Alaska is the relation between the nation's need for Alaska's energy resources and its need for wilderness values. Other issues such as jurisdiction over wildlife and other resources will dictate knowledge searches in Alaska. Although much is known about climate, geology, permafrost, minerals, and biology in Alaska, much remains to be learned.

The subtitle of this discussion is, "I know a little about a lot of things and not much about anything." Since I see a number of my old friends from the last 12 years or so here, I will discuss mostly generalities and very few specifics.

I do want to at least try to wing it, depending on your ethnic interests, either like Abdul Abbul-Bul-Amir or Ivan Skavinsky-Skavar. I will try to be a champion in the next 20 minutes or less and describe all that we need to know about Arctic Alaska.

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On a serious note, though, I'd like to say that we need a perspective on the question of knowledge. Man never knows enough at any time in our history, for any issue in our history. Knowledge is relative either to places or issues.

We know a great deal about the Alaska environment and its resources; in fact, we know a lot more than we use. We also know that we have more knowledge about Arctic Alaska than we do about the rest of the State. We know more, for example, of the ecosystem processes of the tundra biome than we do about the deciduous biome or, for that matter, the grasslands. We know more about the environmental problems and interrelationship between the arctic environment and oil and gas development than is known about strip-mining in Appalachia.

We need a perspective about knowledge. We definitely need to know and look at knowledge in relation to the problem or the issue that we are trying to solve and the terms of reference that the Congress or any other administrative or legal body gives us to work from. What they prescribe has to be terms of reference for the resource investigator or for the scientist.

The issues of the day bear directly on how much knowledge we need to have. Many of you are getting involved with the exploration of NPR-A. Some of us have wandered around NPR-A for the past 12 years and the benefits or the fruits of that labor possibly should be used by some people, some times.

I am going to try to talk first about the extent of physical knowledge and then get into biological knowledge. I'm going to have to focus first, however, on what the main issue is in Arctic Alaska, and for that matter what drives the whole State of Alaska. It's an obvious issue. The question is whether or not the national needs for oil and gas or energy are going to be met from some of this area and the conflict is with wilderness and wildlife.

If any of you has taken the time to study the President's energy message and do the necessary arithmetic, you'll find that unspoken in that message is the presumption that the United States will find and be able to deliver 10 million barrels of oil per day for the next 10 years from new sources. Where are we going to get it? Therein arises one of the first conflicts, the primary conflict.

There are five places in all of Alaska from which oil or gas might be delivered in the next five years. One of these is Lower Cook Inlet. Here developmental infrastructure is available. New oil and gas production from development could be onstream within five years. If oil and gas were found in the Gulf of Alaska tomorrow, it is most unlikely that it could be onstream for national use within five years. Four other likely places for oil and gas development are all in Arctic Alaska. One is offshore Prudhoe Bay, primarily in the Lisburne structure. There may be other horizons as well, such as along the Barrow arch, offshore of NPR-A. For that matter, Harrison Bay appears to be an attractive geologic situation as does Camden Bay. In the Marsh Fork anticline inside the Arctic National Wildlife Range is an area that if it were drilled and if it did contain an oil-producing structure, could be put on flow within the five-year period. The third oil and gas location is in the Native lands, south of the bend of the Colville River in what is called the Tiglikpuk and Tuligak structures. Some wells are being drilled now by arrangement with Texaco. If an economically viable structure is found, produced oil could be on flow in five years.

The final location is along the Chukchi Sea coast in the area about Point Lay. The structures here are like long upturned canoes that stretch with bows resting about on the NPR-A border, the sterns out into the Outer Continental Shelf (OCS), and the main part of the structure about at the edge of the coast. About four of these long upturned canoelike structures are there. Again, if they were drilled and found productive, economically viable, they could be put onstream through a maritime offshore port in the next five years.

That's all there is! The issue for Alaska and the Arctic is: Will the d-2 situation--concern for the lands, the wilderness, and wildlife--close the door to oil and gas development or not? We will all watch and see what happens. I am not trying to debate this; I personally lean to the environmental side. But I think we have to deal with realities.

Some other issues appertain to this major confrontation situation. One has been a sacred cow to many people for many years; it is the jurisdiction over resident wildlife. This is going to be a major question in the next few years as the sovereign United States attempt to take back more and more jurisdiction over so-called resident wildlife. We've already seen situations such as endangered species and

marine mammals. I think the caribou situation will be another one. Again, regardless of the rationale, it is an issue and it is driving, or it will drive, the search for knowledge.

Other questions of a more pragmatic nature are also going to drive the search for knowledge. One is the ownership of the Colville River. Whoever controls the gravel and the water from that river in large measure will have a handle on the engineering development of other areas in the central Arctic.

The policy question which has not been addressed by the United States at this time, but which must be addressed in terms of oil and gas and environmental matters, is the relationship of NPR-A management to OCS management in the Beaufort Sea, particularly in and around Harrison Bay and along the Barrow arch strip from Harrison Bay to Barrow. Unless management is defined, a host of problems will arise that not only involve where the boundaries are--whether the State owns this or the Federal Government owns that or who has administration over what--but that will affect the development of tunneling systems to offshore areas. Everything from causeways to full transportation regimes will be involved.

I've left out another major issue: the effect of the Arctic Gas pipeline decision, which is under discussion in town today. These matters all are part and parcel of the oil and gas energy equation versus wildlife and wilderness.

Given that issue, what do we know and what do we not know? I'm going to present a very quick overview. Let's start with the climate in the Arctic. We have a number of records and stations for climate in Arctic Alaska, ranging from all the way around the coast, Cape Lisburne, Point Lay, (some of the old DEW-line stations have partial records) and around all the way past Barrow to Kaktovik. We have one station of record in the Interior, and that's the earlier records at Umiat. A few exist for Anaktuvuk. More recently, a few records have been kept at the pipeline stations.

The problem that we have is in a predictive sense. Climate or meteorologic conditions are predictable only in a certain way. Aircraft predictions, for example, generally emanate from systems working west to east. I have spent many, many days in the past 12 years trying to get where I could not go because of the weather.

In developmental terms then, we have some problems in understanding the weather systems, particularly in the foothills and the mountains where we do not know inversion situations. We do not know wind velocities in some of the passes. They'll tell you winds in some passes are pretty ferocious and in other passes for some reason you don't get the same thing. Anyway, we don't know much about the velocities of these winds.

Perhaps a half dozen people can tell you on the basis of human experience something about the snowdrifts in many of these passes in the winter. They could be contacted. But in the western Arctic, particularly in Howard Pass and to the west, virtually nothing is known about snow conditions and runoff conditions. We don't have the information that might be needed about hydrologic and climatic interrelationships to plan major pipeline crossings, roads, engineering devices, and other structures.

I'd like to leave climate and go along to our knowledge of coastal matters. In the Beaufort Sea at least, there is pretty general and good knowledge of geomorphology of the coast. The average Beaufort Sea coast recedes an average of about a meter per year, ranging up to about three and a half meters in some areas. We know quite a bit about thermokarst erosion on the coast. We know a fair amount about sediment transport in all areas along the Beaufort Coast, including Camden Bay, inshore Harrison Bay, and inshore Camden Bay. We know something about the ice dynamics in terms of where the different zones are; we do not know enough about them in engineering terms to develop all the necessary structural criteria. We have only spotty information on offshore permafrost from only two sets of work, one in the Prudhoe Bay area and one at Elson Lagoon. In Mackenzie Bay, the Canadians have done some interpolation of their site-specific work with general area seismic reflections that they received from industry. In the United States we have not done that, I assume because of the proprietary aspects of seismic information. We must know something more about offshore permafrost in terms of the various offshore structures, be they tunnels, causeways, or on-site structures.

We know a fair amount about river runoff, terracing, and ice melting in the deltas. We know which deltas are building and something about the rate. We know something about the Pleistocene geology of some of the offshore islands. For example, Flaxman Island and Pingok Island are probably edges of earlier ocean transgressions. We know

a fair amount through the works of investigators from Louisiana State University on lagoon and delta processes, particularly off Point Lay, Wainwright, and the Colville River delta.

The geologic framework of most of the Arctic is fairly well known in terms of structural knowledge. There are gaps and holes, but in general terms we know quite a bit about the geologic framework of the Arctic Coastal Plain, offshore areas, and the Arctic Foothills.

We also know quite a bit about the general aspects of surficial geology but we do not have site-specific information and other surficial knowledge that is necessary for locating camps, pipelines, and so on. I'm sure that when Oscar [Ferrians] gets done walking up and down the Kuna and Etivluk Rivers we'll have the surface information pretty well written down. The kinds of reconnaissance done by investigators like Oscar up and down these valleys will add considerably to what we now know.

If there is one subject that has had a tremendous amount of research and investigation in Arctic Alaska, it is permafrost. We know a good deal about it. One of the terms we're always talking about is the fragile tundra. In the first place, the plants themselves are not that fragile. They're pretty tough to be there in the first place. It's the soils underneath them that cause problems when they are exposed.

Now I'll discuss some minerals, starting with coal. The main area of excellent coking coals is along the Kukpowruk River. We know that this area contains perhaps 25 million tons of strippable coal and vast areas of mineable coal. Theoretically, we know virtually nothing about the mining of some of these coals under permafrost conditions. There's a great deal to be learned in this context, whether we're dealing with strip mining potentials or with shaft mining situations.

Most of the Arctic, as you know, is part of a great sedimentary basin. There are very few areas of igneous rocks and therefore, not many mineral deposits. There are some minor exceptions near Mount Kelly, also in the western Arctic, and the Kuna and Etivluk Rivers. A little gold has been found in the Kuna district. Additionally, there are the possibilities of tin, beryllium, iron, and other minerals in intrusive rocks in the Romanzof Mountains. In

general, however, the occurrence of metallic minerals is not significant in Arctic Alaska.

There certainly is inadequate information to evaluate oil shales in Arctic Alaska. Oil shale exists in a continuous Mesozoic belt along the flank of the Brooks Range, and in some areas, high yields have been estimated, say 146 gallons of oil per ton of shale, with some trace metal association.

In the same general area that some of these oil shales are found in the central Arctic, there also is phosphate. Again, there is not enough general knowledge to evaluate the potential, but some of the best phosphate rocks have been located in that central area between the Kuna and Anaktuvuk Rivers. In the western Arctic they are pretty low grade.

Uranium concentrations up to a little over two percent have been reported in association with some of these phosphates. The amount of uranium generally usable increases as the amount of pentoxide increases. It is possible in the future, depending on economics and so on, that a combination recovery of phosphates and uranium might be attractive, but at present, there is no indication that developmental or environmental costs could be met.

I'd like to switch for a moment to biology, and what we know about the biome. There have been, as some of you know, through the Tundra Biome and its successor the RATE programs, efforts to model the tundra ecosystem to find out what makes it work. Although I'll discuss some of the general aspects of some of the components, I feel that we need to think more in terms of total ecosystem interactions and involvement.

The vegetation authority in the back of the room here can tell you a lot more about it than ever I can. (That's Bill Mitchell.) Basically, we know the plant communities in a micro sense, different kinds of soils and different exposures and situations over most of the Arctic. We do not know all the taxonomic situations. The birches are in dispute taxonomically. (Some fellow comes up with a cross-mutation, and all of a sudden they're a rare and endangered species.) But basically, we do know a good deal about the general vegetation cover of Arctic Alaska, in the terrestrial sense, particularly.

In the aquatic sense, we know a little, but, I would say, relatively less. Quite a bit is known, however, about

the vegetation in the coastal plain lakes and ecosystems. Charlotte Holmquist, a lovely Swedish lady, has been working in these systems for 10 to 15 years, I guess. She has done some excellent work and there are good descriptions, primarily of aquatic vegetation in the coastal plains but also of vegetation in a number of the foothills lakes and other areas. Less is known, however, in the definitive sense in the foothills lakes than in the coastal plains.

In limnology, again we know a good deal about limnology of the coastal plain lakes; we know less about the foothills lakes. Ironically, we know very little of the limnology of Teshekpuk Lake, the large lake on the central Arctic Coast. What we know about the fisheries of Arctic Alaska is by virtue of the investigations that took place for the trans-Alaska pipeline and more recently, for the proposed Arctic Gas project in the Game Range. We know a great deal about the fisheries distribution and life cycles and other facts about fish in Arctic Alaska east of the Colville River. There are arguments about the so-called "old-man fish" and its taxonomics, but they are academic.

We know a fair amount about fisheries along the coastal plains west of the Colville River but less about those in the mountains and particularly in those rivers flowing from the Brooks Range into the Colville from the south. Not much is known about the fisheries populations or the life cycles of fish in some of those waters.

Knowledge of birds in Arctic Alaska is extensive. Perhaps the best known are the shorebirds. Two large and detailed studies were made over the years on shorebirds. We also know a great deal about the waterfowl species in terms of their nesting and migration. There are some mysteries, however. For example, one of the mysteries is where all the eiders come from. More eiders pass Point Barrow than we know nest in Arctic Canada. We know fairly well the distribution of some raptors east of the Colville and also on the coast to the west and around Cape Thompson and Cape Lisburne. We know very little about raptor habitat in the headwaters of Utukok, Kukpowruk, and the Kelly River country of the Western Arctic.

We again have fair knowledge of most mammal species, and the terrestrial habits and ranges of moose, bear, sheep, and others. We do not know much of anything, however, about Dall sheep west of Howard Pass. We know quite a bit about those east of the pass. There are only isolated

bands of Dall sheep or small groups of them west of Howard Pass. At one time they were quite prevalent in that area, but probably have been extirpated over the years.

The largest mystery in the Arctic is the Arctic caribou herd. I don't intend to get into an argument or discussion with all the caribou experts here. All I know is that I have been among them many, many times and watched them. At this point, there is no way that any man can say what really causes the cyclic rise and fall of the caribou. No one can say definitively that it is a range problem or an animal behavorial problem. There is no way that the various modeling aspects of those chaps down in British Columbia can define the problem. I don't think it makes too much sense to many Alaskans who have watched this over the years. We do know from history that when the caribou are in low numbers they generally occupy different ranges than when they are in high numbers. We do not know whether or not the cotton grass on the Utukok calving grounds is there because of site conditions, whether it's been overgrazed over the years, or whether it's a pioneer plant coming in. We don't know whether or not the Utukok is a calving ground in low cycles. I don't happen to think it is, but there's no knowledge of that. All that we're talking about here, particularly in terms of reference of the NPR-A Act, is a challenge for your intellect. The Utukok reference in the Act, for instance, was not written as a definitive instruction for the reservation of these grounds for caribou calving but rather as an example of habitat classification.

With today's low caribou population, it is to be argued, I think quite well, that one should not designate the Utukok as a calving area because it in fact may not be. Nor can you by regulatory measures really protect the caribou. Because of the land tenure situation, you might better go to some other regulatory device.

Anyway, the caribou situation is seen as a mystery, and there are theories all over the place. In the past few months I've gotten calls from Ungava, the Northwest Territories, all over--and there is a general interest in long-term research on caribou.

The other big mystery in the Arctic centers on some of the marine mammals. We do not know the number of bowhead whales, except in a general and highly speculative sense. We do know pretty well the gray whales by virtue of the counts in the Baja, California, study. We do not know much about seal populations east of Point Barrow, although we

know the seal feeding habits and densities in the Chukchi Sea much better than we know those to the west in the Beaufort Sea. The beluga is also somewhat of a mystery. Nobody really knows their feeding habits, particularly during the summer migration.

One of the things that has constantly disturbed the land managers or land resource specialists in Arctic Alaska is consideration of the value systems of the people involved with various uses of the land. It must be accepted that value systems of some of the Native populations and our general land interests are not the same. That doesn't mean that you don't see in the Native emerging scene the old Caucasion approach to life that they want to eat their cake and have it too. In case of oil and gas, the view is a la Texans on the one hand and toward subsistence activities on the other. But there are different human value systems.

In the dialogue many of you will have in the future, with the North Slope Borough and the Arctic Slope Regional Corporation and the villages, you are going to be confused by these value systems on many occasions. On the cultural aspects, I would only say that the history of man's life in Alaska is of tremendous importance. The travel of man across time here is of extreme importance to us. In western Arctic particularly, in some of the passes around the headwaters of the Noatak, the Kelly River, the Kukpowruk, there are a number of historic sites. I've seen many of them as I wandered around. I'm sure that some fellow who knows what he is looking for will find a lot more.

Paleontology, which is related very much to the travel of man, is an important aspect. Many discoveries have been made in the Meade River and the Noatak River areas. Once another fellow and I pulled a mammoth tusk out of the Upper Noatak. These things can tell us a lot about the history of man and his evolution. The climate, changes in resources, and so on, all up and down the whole area help us understand the present ecosystems and the present environment.

Session 3 Discussion

CHAIRMAN PARKER: We now have 25 minutes for discussion that has been set on this panel. We certainly have no restrictions on what you may wish to discuss. I think it would be most fruitful if we could work our way through some of the particular problem areas that were brought up, so the first one gets to define the problem area. Who's got the first question?

MR. GEORGE OVIATT: Dave mentioned getting some of those resources out in five years. On the washboard anticline of the Beaufort Sea, Dave, what do you project would be necessary by way of transportation in order to get the resources out in five years?

MR. HICKOK: Theoretically, the drilling on that area and the potential, and I was only speaking in potentials, of an economically viable structure is there. It is one of the areas of interest that the oil industry had for many, many years preceding Prudhoe Bay. It is thought to be a most attractive situation from the oil and gas point of view. If it was hit, a feeder line into the existing pipeline would be quite possible and if the through-put was of such a balance that it would allow adding oil in, that would be a source to add on that would be technologically possible in the next five years.

MR. OVIATT: You expect a second pipeline?

MR. HICKOK: I don't think so, not at the present time. It's a question of through-put now. If you're talking about a million five through-put, at the present time the pipe is designed for--what is it?--two million?

MR. PARKER: Is that two million with no looping?

MR. HICKOK: Yes, with no looping. I do think there's some problem with looping, but I would certainly prefer that.

MR. PARKER: There are no free lunches in looping or anywhere else.

MR. HICKOK: I only tried to raise the question, if you stop to look at that, and I would urge you all to do it, look at where oil and gas is possible in the time-frame people are talking about politically.

MR. SANTORA: Any time you focus biological terms of the Arctic on oil and gas, when you refer to being in conflict - do you actually feel it's not what we do but how we do it? If adequately addressed, do they necessarily have to be in conflict?

MR. HICKOK: Oh, I don't think they have to be in conflict scientifically or technologically but I think they definitely are in conflict politically. I would agree, John. I think we are going to see a tremendous trade-off. That's why I pose the point. The sovereignty of the caribou is going to be part of those trade-offs, and I'll bet my last nickel on that.

MR. PARKER: The conflict comes into the political straightjacket that's put on the process of timing of this. If we're forced to meet arbitrary, unreasonable deadlines, we're going to do certain things in all of this that we're not going to do if we can develop the deadlines through some coherent time process. I think if you were to follow through on a scenario, as Project Independence promised in its earlier phases, you could probably go to a maximum development scenario ranging from Point Lay to Demarcation Point onshore and offshore. Why there would not possibly, under any regulatory regime, be much left of the Arctic Slope. It's how you take a maximum development regime and how far you want to process that over what kind of a time-frame that you're going to determine what the reactions of many of us are going to be. It just depends on whether

you're talking about one pipeline or four, which is what I believe the Navy suggested at one time to the Commission in developing similar transportation lines.

MR. HICKOK: I recently wrote a paper with Arlon Tussing. He wrote on some of the economic and environmental resource issues. One thing that is inherent in this whole oil and gas picture and environmental picture of the Arctic is that the driving force behind oil and gas is leaving the Federal Government, it's leaving the State Government. In the present context, it is going to go to the Arctic Slope Natives. They've got most of those possible structures trussed up under lease arrangement, and we don't know what will come of that. But the ball game in terms of pressure economics is going to change.

MR. PARKER: Assuming that major finds are made in those particular areas, the way in which the transportation planning is worked out--since that will involve both governments, of course--that is going to be the major effect on future planning. It can create situations through private developments, which will make it extremely difficult to come up with the scenarios within the present statutes that are going to put any particular guarantee of wildlife preservation. You know in Arctic Alaska you can certainly throw it back to the local government and the Arctic Slope Native Corporation by involving them very early in these decisions and forcing those two particular entities to face up to the long-term aspects of the decisions that they are in effect serving as the trigger-men for.

MR. HICKOK: One thing that disturbs me in the process of NPR is the planning. To be absolutely blunt about it, I said the same thing to members of Congress in the last couple of weeks in this context. I would not be surprised to see an Oversight Committee on NPR investigations some time this fall. My point is, under the Naval Petroleum Production Act, it was quite clear that there would be a very good partnership between the Federal Government Interior [Department] and the Natives, both the Borough and Regional Corporations, and the State of Alaska, because of internecine warfare in Interior. I don't think that Interior has achieved a decent partnership with the State or with the Native population. This, in itself, will be an issue before this thing is over. Also by the way, in all respect, I don't think the other Federal agencies have been fair to BLM. BLM has the name but it doesn't have the game.

MR. PARKER: Yes, I think that's happened more than once. A particular agency has been targeted through the past several years of our development scenario to bear all the sins of the spectrum rather than to take over its own particular responsibilities and solve those in a competent manner and leave the rest to the Government. I think Congress has probably been guilty of creating some of this syndrome and certainly the agencies themselves have. I think that unless we do develop some better mechanisms for regional coordination--in this case, I would say the region would be north of the Brooks Range--we're not really going to improve the situation no matter how much more knowledge we accumulate. There's no point in accumulating knowledge and then not having a political structure through which to implement it. That's the most critical thing facing us right now.

MR. PARKER: Anybody else have a question?

MR. OSCAR FERRIANS: I'd like to find out what you think would be the appropriate structure by which we can get proper coordination between the Interior Department, State, and the Native Borough?

MR. PARKER: I think there're several levels that are needed in the NPR-A Act to lay down a basic regional level through which coordination was supposed to be achieved. What Congress failed to recognize in spelling that out is all of the other agencies on both sides which have interests but are not necessarily in the Act. On the State Government side, of course, you can always just designate a State when you have it there. But on the other side, with the problem of the lead-agency--this is the one that is still nagging at us. Whether some of the reorganizations that are contemplated will take care of that in making one Secretary responsible I don't know. But the other levels that are needed up and beyond the Arctic Slope level are certainly from that espoused into a statewide planning context. The effect of what is going on--on the Arctic Slope, on the overall economic development in the State of Alaska, on the overall ongoing development of social relationships between State agencies, the North Slope Borough, the inhabitants of the Arctic Slope that feel the Borough is not representing them and don't want relationship directly to the State and that sort of thing--there's an area where things start to get muddy. When you get back to Washington, D.C. and all of the Departments concerned are each carrying their own separate torch before Congress, why then you have to carry the coordination through at all three levels, from the

immediate regional level in the State, to the State level in the case of Alaska or regional level for the rest of the States, on through to Washington. I feel that this without bogging the whole system down hopelessly is something that is going to call for some fine-screen structure. In getting back to discussing things right on through on a functional basis, that way we'll get too far adrift at least until the policy makers at the Washington level clearly understand one particular problem. We had tried to generate that particular dialogue by making some suggestions in Washington to reactivate some of the coordinating committees at that level that existed in the past between agencies, to at least see if we can't get a development going of overall fine-tuning of some of these problems. The big difference is that we just make these massive movements of resources between various regions in the United States now on a continuing basis and we've got to have more. So everything that happens on the Arctic Slope is going to have massive management impact from now on.

MR. HICKOK: It's going to get worse before it gets better. I think with the energy reorganization situation, we've got some real problems in terms of NPR-A. At the moment you know there are five different outfits tugging on this haywagon in five different directions. It seems to me that with the two USGS groups, one on exploration and another on environmental impact, two BLM groups, one on land-use study and one on regulations, the Presidential Committee - or Interagency Committee on Mineral Policy - at the moment in Interior there is no focus for the direction of NPR-A work in its entirety. Arlon Tussing and I went to brief the new Assistant Secretary Davenport on NPR-A and it was quite an experience. She was a nice, good-looking young lady but other than that, she was more interested in the ducks, the geese, and the swans and stuff than she was in the mineral situation, which is a nice environmental posture. But in terms of the way our Government operates as a system of different adequacies, one ostensibly as advocate for mineral policies and another one for fish and wildlife, when you have the mineral policy people more interested in the ducks and geese and the OCS people more interested in fish, then I think this system of Government has got some problems. I talked to the Senate Committee a couple of weeks ago on the reorganization as it would affect NPR-A, and they are very, very worried about this. What happens is we make an Energy Department and the Interior then becomes the Department of the Environment. The argument that we were discussing for the different groups among agencies,

then is escalated to the White House and this is just madness. So, I don't think it's going to get better very quickly, but I think it is something to worry about.

MR. PARKER: There has been a great deal of role confusion in recent years.

MR. SANTORA: Land contiguous to the Petroleum Reserve has been conveyed and the structures that are there could essentially be producing horizons. The fact that these structures carry a different land status there is urgent. In fact, Dave mentioned the other landlord up there and that's the Natives. They've got quite a piece of land in fee. If they find producible petroleum on their land, I'm sure they're going to want to develop it. I think it behooves the State and the Federal Governments both to know what potential reserves they have on their respective lands and have it developed ultimately. You can't develop one piece without having a vehicle for ultimate development of all of it.

MR. PARKER: You're dead right. If you look at some of those structures and some of the land ownership, it is quite conceivable that very quickly all three will have to get into unit agreement. But then, the structure for doing that certainly exists within State statutes but the climate for achieving it would probably be a somewhat tortuous route.

MR. PARKER: One of the angles on this, John, which people are overlooking is that in exploration terms, the Arctic Slope with its oil company arrangements spent 44 billion dollars in the last three to five years on seismic exploration. They have the most sophisticated seismic work available that anybody in the Arctic has.

MR. EDWIN "ROCKY" RHOADS: I'd like to further expand the point that was just made by Dave that in the actual areas of potential development there will have to be some addressing of all three agencies, Federal, State, and Native, if development is going to expand by necessity of logistical support and transporting the product out. The rocks will very likely transect areas of all three agencies, all three owners.

MR. PARKER: Yes, I think it's important as things go forward that everyone has a clear understanding very early in the game as to where the ultimate decision-making authority is on some of these particular areas. If a

major pool were found in which all three were involved, where would the ultimate authority to designate the manager come from?

MR. HICKOK: Well, there is a case. There's a place called Ivotuk which is an Eskimo word for "whale blubber rock." Ivotuk is a large structure right there on the NPR-A boundary against the Southern Foothills. A good deal of this is on Arctic Slope land and the other is across the boundary. The oil companies that are involved with Arctic Slope think this is the hottest prospect they've seen anywhere in Arctic Alaska since Prudhoe Bay. It's a real situation; it will come home just as soon as the d-2 thing gets to Congress. But some of this also is dual withdrawal land, and there are some problems there. We're going to see the energy dialogue led by the Senate side. There will be a compromise, as there always is, as education progresses in the Congress. It took us five years to get the Native Land Claims Act through - don't forget that! That was five years from the moment the Federal Field Committee bill was introduced for passage. Even prior to that, there had already been a dialogue. But once the framework of legislation was up, it took five years. This d-2 thing will probably take three, anyway.

MR. PARKER: As far as I'm concerned in a situation such as Dave was describing, the State Conservation Committee is the controlling authority for unit management in areas under joint management. If the Federal Government doesn't accept that, now is the time to wrangle it out and not after we make the plan. I'd like to see a lot of these legal questions settled now, so that we all know by what rules we are playing rather than jump into an OCS-type lawsuit after the problem develops.

MR. HICKOK: Thank you all very much! Anything else?

MR. COPELAND: I have one question for Dave - you spoke to 94.258 [the Naval Petroleum Reserves Production Act] that Teshekpuk Lake and Utukok areas are only used in the Act as an example.

MR. HICKOK: That is correct, Bill.

The Naval Petroleum Reserves Production Act

Richard H. LeDosquet*

I'm a little embarrassed about Jules or Jim--they really didn't consult with us very well in regard to setting up this meeting as to the dates. I can't pass this opportunity to remind them that this is a national holiday to some ethnic groups. For those who might recognize it this is Søttende Mai, the 17th of May, the Norwegian Independence Day. Anyway, we will proceed even though some of us are on a holiday.

I think the catalyst for bringing us all together here was really an Act of Congress passed on April 5, 1976, called the Naval Petroleum Reserves Production Act. That bit of legislation has been alluded to here but not described in any great detail but I'm not going into any detail either. It's the legislation that actually transfers the NPR-4 (Naval Petroleum Reserve No. 4) to the Department of the Interior. That happens in two phases.

As of April 5, 1976, the surface management transferred under that Act, and as of June 1, 1977, the total jurisdiction transfers to the Department of the Interior from Navy. That responsibility is shared by the Bureau of Land Management and the U. S. Geological Survey. To carry out the intent of Congress under that authority, the Bureau of Land Management and the U. S. Geological Survey have entered into a memorandum of understanding and are operating

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*Mr. LeDosquet was manager of the Fairbanks District Office, Bureau of Land Management.

under that document at present. It takes full effect on the first of June when the Geological Survey will take over the exploration contracts that are presently being administered by the Navy.

In addition, that Act provides for some other things to happen. Section 105(b) of the Act provides for development and transportation studies. We have a panel member who will address that from Geological Survey; then section 105(c) of the Act provides for land-use study and that will be addressed by a member of the panel. Our third panel member will address the surface management activities that have been ongoing since the fifth of April last year.

The Land Use Study for the National Petroleum Reserve–Alaska

Sal DeLeonardis*

ABSTRACT
Legislation that transferred PET-4 to the Department of the Interior required that the Interior Secretary conduct a study to determine the values and best uses of lands contained in the Petroleum Reserve. The setting up of a task force to guide study preparation also was required. Recommendations from the study will not be acted upon until Congress acts on them. Responsibilities for the study were delegated by the Secretary to the Assistant Secretary for Policy, Budget, and Administration, who has no field agency responsibility. He, in turn, delegated the study responsibility to BLM, which reports through another Assistant Secretary. The arrangement is awkward. Among problems the task force is encountering are lack of cooperating agency experience with land-use planning and logistics, as well as heavy staff turnover.

*Mr. DeLeonardis is Chief, Planning and Program Coordination Staff, Bureau of Land Management, Alaska State Office, Anchorage, Alaska, and was acting leader, NPR-A Land Use Study Team when this speech was delivered.

I'd like to just for a few moments go through some of the history involved with the land-use study to set the stage and give you a little better insight and understanding of some of the problems and some of the opportunities that are facing us today in the land-use study.

First of all, the legislation requires the Secretary of the Interior to conduct a study to determine the values of and best uses for the lands contained in the Petroleum Reserve. The task force, which was required under the law, was formulated to assist in guiding the preparation of the study.

A number of Federal agencies are legislatively directed members of this task force, and others were also incorporated. The North Slope Borough is a member of the task force and the Arctic Slope Regional Corporation is also a member. Relatively regular meetings are held; in the past six months or so they have been held approximately every month. We hope that this will be one mechanism to assist in coordinating the planning for PET-4.

I think it is critical to remember that nothing that the study comes up with will be activated until Congress acts on it. Congress has reserved to itself the right to call the shots on PET-4 when all of the materials they ask for are in hand, namely the developmental study, the additional exploration program that will be going on, the EIS associated with the developmental study, plus the land-use study with which I am associated.

Now, what sort of progress has been made on the study to date? Initially, the responsibility for preparing the land-use study was delegated by the Secretary [of the Interior] to the Assistant Secretary for Policy, Budget, and Administration. Just a word of explanation: This particular Secretary does not have any of the field bureaus responsible to him. He is strictly involved in policy, budget, and administration for the Department, but he does not have any line-agencies reporting directly to him.

The preparation of the study originally was going to be the responsibility of the Special Assistant to the Secretary located here in Anchorage. The work was to be divided among a total of seven different work groups and the concept was that the work groups would operate essentially independently. When their field work was completed, a small group under direction and leadership of the Special Assistant to the Secretary would prepare and put the entire report together.

The task force accepted this particular organization of the study, and in addition, various field studies were proposed to cover what were felt to be some of the gaps of knowledge as far as preparing a land-use plan. These proposed studies went to the Secretary's office and were accepted as necessary by the Assistant Secretary for Policy, Budget, and Administration.

As things progressed, everyone recognized that this was going to be quite a job. The expertise for a planning process to pull all of the diverse material together really was not located in the Special Assistant's office. Of all the agencies involved, BLM probably is the only one that has any experience and has a process used in land-use study.

Please do not misunderstand. I do not--repeat--not say that other agencies do not do land-use studies or land-use plans. They generally start out with a given land allocation. For example, the Fish and Wildlife Service starts with the premise: "Here is a refuge area, how do we want to manage the refuge?" The Park Service starts with the premise: "This is a park, how do we want to manage the park?" None really has any experience in taking raw land, analyzing the resources of that land, the demands placed upon that land, and then coming up with a mix of uses in any particular area.

For this reason, the study was delegated to the Bureau of Land Management. Here we have a paradox of one Assistant Secretary, who has no responsibility for any field agencies, delegating the study to a field agency which reports through another Assistant Secretary. It's a very awkward arrangement.

When BLM was named the responsible agency for the plan for the land-use study, the Alaska State Director of BLM was selected as chairman of the task force.

What are some of the problems associated with the study, at least as they are obvious to us today? First, as I have said, the organization of this particular study that BLM inherited is an awkward working tool. We will, however, utilize the Bureau of Land Management's planning system with some modification for the preparation of this study. Again, since there was a buy-off on the field studies proposed on the work group concept, we are still going to have to work within that umbrella that we inherited.

As I mentioned, part of the problem that we are encountering is the fact that there is very limited experience in the planning process in the other agencies and not a great deal of understanding as to what this process is.

Admittedly, it is a very complicated process and really the best way to become familiar with the process is to actually work through it, be exposed to it, and operate through it. As a general rule, most agencies (and I am not excluding the Bureau of Land Management from this) place a great deal of emphasis on detailed inventories. Inventories are easy to see and feel definite results from; they are easy to justify. Because of great focus on the inventory, however, in most planning efforts the analysis phase doesn't get the attention it ought to. Yet the analysis really is the critical part, the guts of the planning.

Key items that will be addressed in the land-use study that we are undertaking are conflict identification and the resolution of those conflicts where possible. Where we cannot resolve those conflicts, we will develop reasonable alternatives to satisfy them. In other words, where we have two alternative uses, each of them mutually exclusive, we will analyze each use individually and identify the trade-offs that have to be made, should one be selected over the other.

Another problem that we are experiencing is the tremendous problem of logistics to support a major field effort. A problem has cropped up recently. We have tried to address this. We think we are satisfactorily proceeding to resolve some of those logistics problems. We are working very closely with John Santora on this, and our field parties will comply with the requirements of the State Department of Environmental Conservation.

Some of the problems in logistics are occurring in the overlapping and sequencing of some of the study efforts. It's one thing to consider a field activity that is going to involve only a couple of people for a few days. It's a different story when we start piling one field study onto another and those few people for a few days turn out to be a number fluctuating to as high as 20 for a three-month period. The potential impacts are completely different.

These are some of the problems we are struggling with now. We hope that out of this workshop we will get some of the answers and some guidance on how some operations will go forward this summer. What is the prognosis? A great wealth

of information will be collected on PET-4 this summer and in fact, over the next two-year period. With patience, understanding, cooperation, ulcers, and a few other things, I think we have the capability of coming up with a good study by April 1979. I don't mean to minimize the coordination problem nor do I mean to minimize the problem that was voiced earlier about significant substantial input from the Native people. We think that this is covered in part by the way we have structured the responsibilities of some of our workers. Only time will tell.

NPR-A Developmental / Transportation Study
and
Environmental Assessment Preparation

Charles Sloan*

ABSTRACT
Section 105(b) of the Naval Petroleum Reserve Production Act of 1976 directs that a study be conducted to determine the best overall procedures, in consultation with State representatives, for development, production, transportation, and distribution of NPR-A petroleum resources. Also to be considered in the study are alternative procedures for accomplishing development, production, transportation, and distribution of NPR-A petroleum resources and the economic and environmental consequences of the alternatives. The economic analysis is contracted through the Office of Mineral Policy and Research Analysis, Department of the Interior, and completion is scheduled for November 1978. The Environmental Assessment is being prepared by an interagency task force headed by the U. S. Geological Survey, and completion date is scheduled for April 1, 1979.

*Mr. Sloan, a Research Hydrologist with the U. S. Geological Survey, Water Resources Division, is the coordinator of water resources studies for the NPR-A and is the Alaska Coordinator for the NPR-A Environmental Assessment Task Force.

The Naval Petroleum Reserve Production Act of 1976 will do several things, as Dick [LeDosquet] mentioned. First and foremost, it transfers jurisdiction of the reserve from the Navy to the Department of the Interior. That occurs two weeks from tomorrow, and in honor of this event, the Navy is planning a big celebration. I think that should tell us something right there!

As Dick also mentioned, this transfer of jurisdiction gives BLM the responsibility for surface protection, and that's what this symposium is about. The transfer also gives the U.S.G.S. responsibility for oil exploration through an ongoing contract with Husky Oil. Tomorrow, John Schindler of Husky is scheduled to tell you about some of the changes that are occurring in this operation. Basically, exploration activities include two things: test drilling and seismic operations. Thus far, these activities have been confined to wintertime, but a couple of deep wells are planned that will require year-round operations. The exploration group is also conducting a helicopter-supported geological field program this summer in NPR-A. Other activities for which the U.S.G.S. has been given responsibilities include a barrel cleanup program that goes on in the summer, and operation of the South Barrow gas field. This operation consists of supplying gas to the Naval Arctic Research Laboratory and the community of Barrow and drilling and developing additional gas wells.

Section 105(b) describes what is called the Presidential Study or the Development Study. It directs that some specific things be done in a specific way. First, to be determined in consultation with representatives of the State of Alaska, are the best overall procedures to be used in the development, production, transportation, and distribution of petroleum resources in the reserve. This task has been given to the Assistant Secretary for Energy and Minerals in the Office of Mineral Policy Development. Specifically, Stan Miller in that office is in charge of the work. He is headquartered in Washington, D. C., and the study is being conducted from there.

A few more specifics on what the Act says. The study should include, but not be limited to, consideration of. a. the alternative procedures for accomplishing the development, production, transportation, and distribution of petroleum resources in the reserve; and b. the economic and environmental consequences of such alternative procedures. As the Development Study is being contracted--and the latest information I have is that a prebid meeting has been held

with interested contractors--they are looking at a large contract, something like 25 to 30 man-years involved in preparation of the final report. Bid closing on the contract will be July 15, 1977. The contract should be awarded in September. A draft of the study report is due in July 1978, and the final report from the contract is due in November 1978. To my knowledge no field activities on the surface of the reserve are anticipated in this study.

To get at the environmental impacts of these alternatives, an Environmental Assessment Task Force is being established and U.S.G.S. has been given this responsibility. The team leader has been appointed; he is Bill Schneider. His headquarters for the task force will be Menlo Park, California. I have been appointed his coordinator for contact here in Alaska. It is to be an interagency task force. Letters have gone out from the Director of the Geological Survey to heads of other agencies, requesting assignment of personnel to the task force for a period of 12 to 15 months. By June those task force members should be selected.

We share a data base with the Land Use Study group, and the Environmental Assessment Task Force will be structured parallel to the work groups that are in existence for the Land Use Study. The area of responsibility is slightly different, however. The Land Use Study is pretty well confined by the boundaries of PET-4. The Environmental Assessment Task Force has to look at connecting corridors, distribution, and marketing of any petroleum products that are found there. It is anticipated that a study of the connecting corridors will be contracted, perhaps locally in Alaska, and that the major transportation and marketing study will be done by major contract.

We have a limited time to gather the baseline data for our description of the existing environment. We are limited by manpower. It's a big area and we don't have a lot of data on the geology/hydrology, so we are gathering as much as we can this field season. We are going to rely to a large extent on extending this data base through the use of remote sensing capabilities that we have in the Department.

The geography programs within the land information analysis group of the Geological Survey will do some vegetation mapping. We are getting assistance from the EROS Data Center in Sioux Falls, South Dakota, on some wetlands mapping classification and other things that will be of general use in hydrologic and geologic mapping in that area.

A tentative schedule for the Environmental Assessment is: from February 1 until June 15, 1977, organization, preparatory work, and coordination; from June 15 to September 1, 1977, data collection and analysis; from September 1, 1977, to April 1, 1978, work on the preliminary draft Environmental Assessment; April 1 to September 1, 1978, complete the draft Environmental Assessment; September 1 to December 1, 1978, revise the draft Environmental Assessment and hold hearings; and finally, from December 1, 1978, to April 1, 1979, complete the final Environmental Assessment. The result of the entire Development Study, including the Environmental Assessment, is to go to Congress in January 1980.

Surface Protection Requirements Now in Effect on PET-4

John Santora*

ABSTRACT
Measures should be taken to insure that everyone involved with stipulations understands them. Often, the man in the field is not informed. So far, the program on the Petroleum Reserve has worked well, and little disturbance has resulted from seismic work there. The term "damage" must be defined, and as oil and gas development continues in Alaska, we should learn from past mistakes and apply what we learn.

The theme of this symposium is "Surface Protection Through Prevention of Damage," and I would like to address my comments directly to that theme in a general way.

My experience on the pipeline and also on the Petroleum Reserve in connection with the exploration program has brought me to the conclusion that there is one area which needs to be addressed with regard to the physical actions that are taking place in the field. We can write stipulations and regulations until we're blue in the face, but if we don't have a vehicle to effectively implement them in the field they are useless--they mean nothing. You're better off without them because they just cause a lot of dissension.

*Mr. Santora is Project Manager, NPR-A, Bureau of Land Management, Fairbanks, Alaska.

I feel that we can make great strides, after the stipulations have been promulgated if we provide a vehicle of communication between the concerned agencies and the permittee whereby we can insure that information is being transmitted to the working level in the field.

The experience my people and I have had so far is that when we inquire of an equipment operator, "Are you familiar with the stipulations?", his response has been, "Huh? What are you talking about? I don't know anything about that. I just operate this Cat."

The program simply is not working. The man in the field has to be knowledgeable. Someone has to inform him what is expected of him. Then we can ascertain whether or not he is acting in a responsible manner. If he doesn't know about stipulations, there is a breakdown somewhere in the communications system.

I feel that we have to have a program whereby the line supervisors in the field and the camp managers are cognizant of stipulations and knowledgeable about them. They must know what the intent is and insure that this intent is transmitted to the worker.

The program for NPR-A basically has been good. We've had problems; there's no question about that. Of the 2,650 miles of seismic line that have been completed for this winter's program, there was disturbance along one percent of that mileage. I use the word "disturbance" because it's questionable whether damage has occurred.

I will digress here just a minute. The symposium title is, "Surface Protection Through the Prevention of Damage." If I ask each of you to write down your definition of "damage," I dare say I wouldn't get more than four answers that were the same. We have to define the term. We have to quantify what we mean by damage. I have a definition, and I hope a definition is one of the things that will come out in the work session planned for this symposium.

How do we mitigate damage? How do we prevent it? Any time we do anything, whether it's just walking across the tundra or actually digging it up do we cause damage? You can't even walk on the tundra without damaging it, according to some people.

I feel that the NPR-A stipulations for the civil, drilling, and seismic work are adequate. This does not include year-round drilling, however. The problem in the real world out in the field is to see that all project employees are aware of what is expected of them. If they are not aware, steps should be taken to insure that they are. If they continue not to comply, they should be replaced by someone who will comply.

My final comment is simple. We've done much in Alaska to develop arctic exploration and production techniques for oil and gas, and I'd like to leave you with this one thought. The only mistake we really make is the one we learn nothing from. I do hope we learn from our mistakes in the past and apply what we have learned to development that is facing Alaska now.

Session 4 Discussion

MR. CARL JEGLUM: Are you using the standard Bureau planning system in your URA--RI instructions?

MR. DeLEONARDIS: Yes, we are. What we have done, though, is crossed out all of our institutional terms. We just didn't want to confuse it with a bunch of terms that nobody outside BLM would understand. We tried to drop those and use instead general terms that really express what they mean. URA doesn't mean anything to anybody. Resource Inventory and Analysis perhaps does. Those are the changes that we made. The process essentially remains as it is set out in the Bureau planning process.

MR. HICKOK: I am somewhat troubled about the jurisdictional problem as NPR-4 becomes NPR-A and you go from the confines of legislative jurisdiction to proprietory jurisdiction. You just mentioned that you are going to have the State Department of Environmental Conservation do something in accordance with what they want, is that correct? If so, what?

Then the second question along the same line. There is in the U.S.G.S. - BLM agreement no mention whatsoever on the water problem. Who's going to allocate the water resources? Who is going to make the decisions on water?

MR. DeLEONARDIS: That's a good question. I will defer the first question to John as he is the one who has been

saying we are going to follow the DEC restrictions that have been placed on everybody who has been operating on the Arctic Slope to date, off the Reserve at least. John, do you want to elaborate on that?

CHAIRMAN LeDOSQUET: Could I interject one thing here first? I think I failed to introduce John. He is the Project Manager which is equivalent to an Area Manager in the other parts of our organization. He has total responsibility delegated within the Reserve and he carries out all of the programs for Bureau of Land Management within that area. That's why it is indicated here that John would do coordinating and so on. This is different from just being a staff member.

MR. SANTORA: The Federal Government, in this case the Bureau of Land Management, in discharging its responsibilities on surface management and reserves is not shirking that responsibility by saying that we will require the same standards the State does and that have been developed in cooperation with Alaska Oil and Gas Association (AOGA) for exploration and field activities in the Reserve. We can't put an arbitrary line down that and say, "The Federal regs will be over here and State regs over there and they are different." It's ridiculous. If the regulations are meaningful and viable for the type of operation that is being conducted, they should be the same for everybody. I don't like fighting over who is going to write what piece of paper. That's another thing I consider to be ridiculous and I refuse to do that.

As long as we adequately address the environmental concerns that exist in the Reserve in connection with the exploration program and in the field, we're doing our job. I don't care how much the lawyers want to fight back in Washington over different interpretations of definitions and legislation. There is still a job that has to be done in the field and that rests with the folks that are working out there. They've got to have some direction and guidance to know what is expected of them. That's why I adopted that policy.

MR. HICKOK: You missed the point, however. Are you going to have the State make these or are you going to make them, using the State's regulations?

MR. SANTORA: I'll do it using the State's regulations. Where Public Law 94.258 applies, there are so many requirements that have to be met in connection with fuel storage

and solid waste management and those permits will be obtained. I've already talked with Jerry Brossia and have invited him to make inspections with our people in the field in that regard.

MR. DeLEONARDIS: I think the point, Dave, that you were trying to make is that we are not relying on DEC. We will impose what DEC has come up with in the past as operating instructions and make them part of BLM's operating instructions.

MR. HICKOK: I think you're on tremendously thin ground to give the State of Alaska any jurisdictional authority until somebody decides to do it by virtue of future request that Congress wants to do it. A number of laws automatically go to the State on this question, things like fuel source and so on. But there are other aspects, for example, a number of questions have not been decided on State water laws in Federal proprietory jurisdiction. I don't want to scare anybody out of this one, but there is a large body of opinion that doesn't believe the aboriginal water rights were settled by the Native Land Claims Act. So there is a whole set of ramifications here I think need to be given careful thought.

MR. DeLEONARDIS: Dave, we're not treating water rights, I let that part of the question dangle for a moment. Primarily, what we were talking about was solid waste disposal, human waste disposal, water supply as far as the purity requirements are concerned and so on. For those kinds of things, we're adopting the DEC requirements.

Water supply is a different problem. I don't know if this has been addressed or addressed in any depth or detail. Jules, can you respond to that?

MR. TILESTON: No.

MR. SANTORA: Perhaps I can clear up this point a bit. When I say that we will be adopting guidelines which are compatible and parallel to the States, I am referring specifically to the ongoing exploration program and how certain of those requirements relate to that program. In other words, we're not getting into navigability question or the anadromous fish question. We don't even get involved in Title 16 because we're not doing anything in the rivers. There's no planned disturbance of those rivers whatsoever. However, if we're going to put a seismic crossing in or a bridge or something else in the development stage (if it

ever went to the development state), then that would have to be addressed right now to our program. We hope it's a first step to try to get these various interested groups together as we discussed earlier. Somebody has got to start someplace, somehow. It's hoped they will work together not as a committee (because that is chaos) but as a team. When you have a team, you have a leader, you've got a purpose, and you're all working together to accomplish a goal. I don't think we're doing that right now, either. But we do hope it will change.

Surface Protection from an Engineer's Point of View

Don Keyes*

ABSTRACT
Construction of the trans-Alaska pipeline was done under an agreement that included stipulations that probably made the project a first with environmental controls of this magnitude. Under the stipulations pesticides, herbicides, and chemicals used during construction had to be nonpersistent and immobile. Waste disposal is another problem and its solution had to meet stringent standards. Operation of vehicles off the right-of-way is a problem that can be controlled by various management and technical means. Conflict with fish and wildlife also was controlled under stipulations, and included adjustments to prevent impeding fish passage and caribou migration. Monitoring for quality control is contingent on experience, commitment, and authority to enforce stipulations--and it can mean the difference between acceptable and unacceptable results.

The subject this morning is surface protection from an engineer's point of view. Surface protection is more than just thinking in terms of disturbance caused by construction. I'd like to talk about many facets of the lands,

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occupancy of the land, and things that occur during occupancy.

The examples that I am going to discuss are related to the trans-Alaska pipeline project, which has been under way since 1970, and the trans-Alaska Pipeline Agreement and Grant of Right-of-Way. The agreement has stipulations, among the first, I believe, of this magnitude. I would like to relate some of the problems of surface protection.

We have a stipulation that says pesticides, herbicides, and chemicals used must be nonpersistent and immobile types. We all recognize that when men are out on the job on the Arctic Slope we use insecticides to try to kill the mosquitoes. This is ineffective because the next day, the wind blows in another batch. We use herbicides to try to kill undesirable plants, and chemicals such as calcium chloride as a dust palliative to control dust in the construction operations and on the haul road.

Another problem associated with man's activities is solid waste management, which must comply with the State Department of Environmental Conservation standards. Solid wastes include combustibles, and burning must be handled in conformance with State air quality standards. Proper equipment must be used for an acceptable discharge to the environment.

Man creates sewage, and on the pipeline project there are package-treatment plants to process the sewage to minimize the effect of discharges to receiving water bodies. To accomplish this the treatment plants remove more than 85 percent biochemical oxygen demand (BOD). The effluent from the plant was further held in temporary ponds to eliminate the discharges of BOD loads to water bodies during critical periods. Ponds were discharged during the summer months so the water could accept a small BOD without harm. Solids from the treatment processes were incinerated and the ashes placed in approved landfill.

Another phase of surface protection is the operation of vehicles off the right-of-way. This can be controlled and result in acceptable surface disturbances. We recognize that any activity on the ground will cause disturbance but the point is control. Traveling overland when the ground is frozen on the Arctic Slope can result in very minimal damage if our dozer blades are kept off the ground. Special tracked vehicles can be used to reduce the ground pressure and cause very little damage to the underlying vegetation mat.

Traveling on ice has proved to be very acceptable. In the spring the ice melts, and very little surface disturbance results. This was demonstrated during mobilization on snow pads north of the Yukon River on the Hickel Highway in 1970 and again in 1974. But even low pressure tired vehicles like Rolligons, when improperly operated, cause surface damage. The results are long-lasting on the Arctic Slope.

Construction activities can be scheduled to reduce conflict with wildlife critical periods, such as fish migration and spawning. Perched culverts do not meet the criteria for fish passage but well-designed and installed structures provide adequate fish passage so the fish can use the upstream waters.

We are concerned also with providing unrestricted animal movement. Roads and pipelines don't appear to be in conflict with the caribou movements. Animal crossings were designed and built to reduce the impact of the pipeline on animal movements.

One human problem was the feeding of the animals, namely bears. As in all parks the animals get friendly, and you must keep the proper respect for these critters. Animals recognize a free chow line and come in very close to receive a handout.

Insulated/buried pipeline was installed to test if caribou will use the area. There have been reported crossings of caribou through these areas as well as under the pipe. Even though the pipeline is insulated, the insulation does not prevent heat loss but only slows down the end result. Heat pipes are installed to keep the permafrost frozen.

Site planning should provide undisturbed buffers to separate the activities from vulnerable or valuable resources. This road is located back away from the stream; material sites were also located with buffer strips to separate the stream from the activities.

Sewage holding ponds on the Arctic Slope received water from sewage treatment plants to prevent the immediate discharge to the streams. When roadbeds concentrate sheet flow through a culvert in high ice-rich areas, catastrophic erosion combined with thermal degradation can result and cause head-cutting gullies that require very extensive erosion control measures. One is just downstream of the

haul road at a 24-inch culvert. It caused a gully about 10 feet deep and 20 feet wide, and in a matter of a month, 30 days, it had become about 1,000 feet long. The solution was to place styrofoam insulation on that permafrost, backfill the gully with erosion-resistant materials, and provide an artificial channel for water to flow off the slope down to the river. This prevented hydraulic erosion.

On the Arctic Slope a drainage culvert placed across the haul road concentrated drainage and caused an erosion problem. Alyeska expended a lot of effort to control the water flow across the gas fuel lines out into the natural streams. The surface disturbance that parallels the road is the surface of the gas fuel line installed at the toe of the haul road. Half-round culverts are used to get the water across the ditch during this period when the surface is not revegetated and is vulnerable to erosion. When it is vegetated it will be more stable.

Slopes require more extensive erosion control practices. Cross-draining and revegetation will help keep the water from concentrating and will make the soil more stable and erosion resistant. Revegetation of areas will provide long-term erosion control. Hydroseeding and mulches helped control erosion on slopes.

All operations need contingency plans for implementation when the unexpected occurrence warrants. An oil skimmer is provided for the operation of the pipeline in case there is a spill at the terminal. At inland sites when water bodies are contaminated with oil, skimmers are used to remove surface oils. Other cleanup measures include burning surface oil and putting out absorbents for long-range cleanup. Some seeding may be needed to revegetate the area.

Material sites are one of the major effects of construction in the Arctic, since most construction has been from gravel pads and gravel has to come from a source. Material sites have to conform to our Code of Federal Regulations 43 CFR - Part 23 Requirements, which have proved to be quite acceptable standards for planning, developing, and restoring material sites.

Water-related sites need special buffers and operating procedures to minimize stream effects. Settling basins were provided for water that flowed through the material sites during extraction. Sediments settled so the discharge at the lower end back to the river was better quality. Dikes were installed between the river and the material site, but

during breakup the material sites were inundated by the river. I believe after two or three flood stages the material will be rearranged to obliterate the signs of activities. At the conclusion of operations disposal sites and material sites will be revegetated to control long-term erosion.

One of the construction techniques is to place a gravel pad on the tundra. In the areas where gravel or mineral materials are in short supply, insulation is placed on the tundra before the gravel to reduce the amount required to sustain permafrost conditions.

Another technique is the use of snow roads on river ice for winter travel with all types of vehicles. A snow-manufacturing device brought in from a ski slope was used to make snow that was used for a snow pad. This snow has a high water content and is sticky material. The equipment operating on this pad continued to spread it out over the tundra ahead and operate on it. It took only 30 minutes to set up until trucks could use it and was a good protective layer for the underlying vegetation. This operation was necessary only to get into the site work early in the season.

As soon as Mother Nature cooperated and snowfall was normal--only 10 to 20 inches on the Slope--they used natural snow. The snow travels horizontally one way or the other frequently, in fact, almost all the time. So with an obstruction such as a snow fence, it's not very long before a supply of snow is available to be bladed out, dragged, and allowed to sinter overnight. The next day all types of equipment can operate on this snow pad. In fact, the large truckers would detour off the gravel haul road onto this snow pad for five miles, then back to the gravel haul road and on to Prudhoe. They traveled at 65 miles an hour and detoured to get away from that gravel road just for a few miles.

Windrows of snow are also good collection devices, for the next time the wind blows you'll have more snow. This past winter Alyeska wasn't too careful about opening the pad, and by spring the drifts were over 15 feet deep. They were collecting more snow than they knew what to do with. Even heavy tracked vehicles weighing over 100,000 pounds traversed the snow pad without damaging the underlying vegetation.

In the summer with the snow melted, there's no visible surface disturbance and no interruption of surface drainage patterns, including sheet flow. This is quite an environmentally acceptable method of construction in the Arctic.

Lakes with five feet of ice can support the heaviest aircraft and provide very acceptable landing strips for winter operations. In the spring when the ice melts there's little obvious impact from the activities.

An ice bridge was constructed across the Yukon River. The bridge was 2,400 feet long and about 200 feet wide. Surface applications of water provided the necessary ice depth to develop structural strength to support all types of equipment.

A gas fuel line was constructed by Alyeska from Prudhoe Bay to Pump Station 4, 140 miles from the north coast to the foothills of the Brooks Mountains. This is the fuel supply for the prime movers at Pump Stations 1, 2, 3, and 4. It begins as a 10-inch gas line and reduces to an 8-inch line. It is buried all the way. The gas in the pipeline will be chilled to 28°F and will not melt the permafrost. The construction using snow pads and some good techniques has resulted in some very acceptable results.

Snow pads were constructed for pipeline building operations this year, and there was too much snow. Blowers were used to blow it off the right-of-way. You have to build snow roads up in thin layers.

After the excess is pushed aside, the surface is dragged by motor patrols. Six major pieces of equipment were used to construct one mile of road or workpad 50 feet wide and one mile long, per day. The snow pads are built well ahead of the construction activities.

Because the ground was frozen, Alyeska had a machine developed called a rock saw. It's a D-9 tractor with a chain saw attachment on the rear, with a second D-9 tractor engine on the front for ballast and for power to operate the chain saw. The chain saw excavates a very narrow, precise ditch in which to place the gas line. This was successful except in a few areas where they hit large boulders. This machine operating through a snow pad cuts a very neat trench that is less than 18 inches wide.

Also in the Arctic Slope area Alyeska used a Barber-Green wheel excavator to supplement the rock saws because it

works very well in fine-grain frozen materials. It makes good progress, about 5,000 feet a day. In the areas where the rock saw didn't work, tractor/rippers tried to excavate the trench. They ended up having to drill and shoot the ditch, in other words, blast. That resulted in the trench opened up 6 to 8 feet at the top.

It must be pointed out here that Alyeska operated this equipment and performed all necessary operations to build a pipeline at -50°F temperatures and with the short daylight hours.

This year Alyeska developed a conveyor belt with an "elephant's trunk" as it's called, which deposits the backfill material in the trench on top of the pipe. This reduces the amount of spillage of material on the snow pad. Last year the snow pad had to be cleaned up right at breakup. Note here that the dust from the haul road has caused ablation of the snow off the right-of-way and that the snow pad with its thin layer of mineral materials on the surface has survived longer than did the snow in its natural environment.

In the spring when the snow melted, you could see some disturbance where the blasting technique was used in the trenching operation. The backfill will be seeded with grass.

In areas where the rock saw was used, the only disturbance looks like a little mole trail--a little line of soil that's about 18 inches wide and 6 inches high on top of the trench. The gas line is installed just off the haul road and the disturbance is minimal. But even so, there can be cross-drainage erosion problems. Any time sheet flow is concentrated we have to watch very carefully to see that the channel will accept that erosion potential.

In conclusion: The difference between an acceptable and unacceptable result can be monitoring quality control, contingent with experience, commitment, and authority to enforce the stipulations. I'd like to define "stipulations" for you. According to Webster's dictionary, stipulations are "to specify as a condition or requirement of an agreement or other; to demand an express term in an agreement." "Specific" means precise, definite, explicit. Let me give you a couple of examples to consider when you're writing stipulations. "Permittees shall perform all activities so as to avoid or minimize disturbance to vegetation." What does that tell you? That's Utopia!

Now let's use a better example. "Permittees shall not operate mobile ground equipment off the right-of-way, off access roads, off State highways, or authorized areas unless approved in writing by the Authorizing Officer." Now <u>that</u> tells us something! The first one did not.

Special Measures to Protect Fish and Wildlife on the Trans-Alaska Oil Pipeline

James E. Hemming

ABSTRACT
The Joint State-Federal Fish and Wildlife Advisory Team (JFWAT) was formed to advise the State and Federal Pipeline Offices on wildlife concerns during trans-Alaska oil pipeline (TAPS) construction. The greatest wildlife impacts from construction now appear to have been siltation of aquatic habitat, blockage of fish passage, and shifts in caribou distribution. Among stipulation changes, JFWAT recommends that undisturbed buffers between pipeline housing, maintenance, and fuel storage facilities and streams be increased from 300 to 1,500 feet. Several pipeline facilities were relocated to protect the peregrine falcon. The observed response of female caribou to construction indicates that utmost caution must be used when proposals show that development may encroach on caribou calving grounds. A great need for detailed resource information continues as other arctic development is planned. Interagency cooperation has deteriorated and should be restored.

The Joint State-Federal Fish and Wildlife Advisory Team (JFWAT) was formed because of early recognition of the need to provide special protection for fish and wildlife resources during construction of the trans-Alaska oil pipeline.

This team of specialists offers advice jointly to the Alaska Pipeline Office, Department of the Interior, and the office of the State Pipeline Coordinator. The team effort by approximately 30 biologists was made possible through the cooperation of the Alaska Department of Fish and Game (ADF&G), Bureau of Land Management (BLM), National Marine Fisheries Service (NMFS), and the Fish and Wildlife Service (FWS). Each provided professional guidance and administrative support as necessary for this joint team effort.

The impact statement and public testimony for the trans-Alaska pipeline had previously placed primary emphasis on the unique values within the tundra zone of the Arctic Coastal Plain. The endangered peregrine falcon, barren ground caribou, and some species of waterfowl and shorebirds received major attention at that time.

Very little information about critical habitat or areas of sensitivity that may affect various fish and wildlife populations existed prior to pipeline construction. Special studies were developed through the efforts of the Alaska Interagency Fish and Wildlife Team (not related to JFWAT). The Alaska Interagency Fish and Wildlife Team consisted of representatives of the various resource agencies operating within Alaska. Participants included the Environmental Protection Agency (EPA), ADF&G, FWS, U. S. Geological Survey (U.S.G.S.) and Alaska Department of Environmental Conservation, plus the U. S. Coast Guard, U. S. Army Corps of Engineers, Alyeska Pipeline Service Company, and the University of Alaska.

This group functioned to provide baseline data on the distribution of natural resources, the description of sensitive areas, and the effects of arctic development on wildlife and fish. Unfortunately, construction began before many of these baseline studies were completed. As a matter of fact, we are still in the baseline data-gathering phase. For example, we continue to find new fish streams within the pipeline corridor each summer after breakup and probably will for several years.

Based on reports from JFWAT monitors and research biologists, the greatest wildlife impacts from pipeline construction appear to be the siltation of aquatic habitat, blockage of fish passage, and shifts in caribou distribution.

Siltation was caused primarily by the mining of gravel within the flood plain of the Sagavanirktok River and cross-

ing of streams and rivers during pipeline construction. Additional problems were encountered during construction of a fuel gas line for TAPS when snow pads melted before construction was completed in the spring of 1976. The result was erosion and siltation of streams on a fairly massive scale.

Blockage of fish passage was basically the result of improperly installed or poorly designed drainage structures, such as low-water crossings or fords, culverts on the workpad, and culverts on the haul road north of the Yukon River.

Shifts in caribou distribution are being studied. During the past three years, Dr. Ray Cameron of the Alaska Department of Fish and Game has been evaluating the effect of the trans-Alaska pipeline on caribou movements. He is working under the auspices of the Joint State-Federal Fish and Wildlife Advisory Team.

The project designs that were approved by the government included specially buried pipeline segments for caribou passage. Earlier research had demonstrated that the caribou tend to avoid elevated pipe. Thus far the data have revealed that there is a Central Arctic caribou herd, a population which we did not know existed until these studies began. The female segment of the Central Arctic caribou herd apparently has abandoned portions of the calving areas that they used earlier. For example, before 1974 parts of the Prudhoe Bay field development area and some areas adjacent to the trans-Alaska pipeline were used for calving. Since 1974 the cow and calf segment of the caribou population has completely shifted away from the development area. Unexpectedly, the males do not respond in the same manner. Bulls continue to use the Prudhoe Bay area and are often seen in the pipeline construction zone, along runways, on roads, and sometimes moving under elevated pipe.

Because of the response of female caribou to construction disturbance, it has not been possible to determine whether or not special passage structures that were built into the pipeline system will provide free passage. The answer to that question will probably be pending for several years in spite of intensive research.

The significance of this information is that we now feel that the utmost caution must be used in evaluating any development proposal that may encroach on caribou calving

areas such as oil or gas field developments within PET-4 or subsequent construction of pipelines across the Arctic Slope.

Earlier in the project, a great deal of emphasis was placed on waterfowl research. Most of this was conducted by the U. S. Fish and Wildlife Service. We soon discovered, however, that waterfowl were little affected by pipeline construction activity. It appears that the major reason is that much of the pipeline is located some distance from major nesting areas within the flood plain of the Sagavanirktok River. Except perhaps for one lake at Pump Station One, no lakes were drained by the project. The long-term hazard of oil spills affecting nesting habitat is perhaps the greatest threat to waterfowl populations on the arctic coastal plain.

Mr. Keyes referred earlier to trans-Alaska pipeline stipulations. One stipulation that should be changed deals with buffer strips. Trans-Alaska pipeline stipulations require a 300-foot buffer strip of undisturbed vegetation between pipeline facilities and streams. We've had problems with major oil spills at essentially all pipeline camps on the Arctic Slope. Earlier we had trouble with sewage effluent from camps affecting the stream systems and aquatic habitats. Therefore, we recommend that on future projects undisturbed buffers of at least 1,500 feet be retained between pipeline facilities and water bodies. We hope that a suitable buffer would contain the various pollutants so that they could be removed or detoxified before reaching aquatic systems. This is perhaps our most significant recommendation for stipulation change. We will make other stipulation recommendations in the near future.

A great deal of attention was directed toward protection of the arctic peregrine falcon which nests at Sagwon Bluffs and Franklin Bluffs along the Sagavanirktok River. Early in the project, a communications tower at Franklin Bluffs was relocated away from the nesting sites and the first proposed Franklin pipeline camp location was denied and the camp site was changed. Later, the haul road itself was relocated when it was in the proposal stage. Significant realignment was made to the west to take it away from the Sagwon Bluffs. In addition, Pump Station Two and its associated communication sites were moved to new locations at Sagwon because of potential impact on the peregrine falcon. We were also able to get the Federal Aviation Agency to issue flight restrictions near nesting areas.

BLM and ADF&G acted together in identifying these nesting areas as critical habitat for further protection by the government.

Many problems that we encountered could be handled by proper enforcement of environmental stipulations during construction. Influence on the location of facilities, however, was possible only where sound resource data were available early in the design phases of the project. Where we lacked data, the potential for construction impact was sharply increased. For example, data on fish overwintering areas were sorely lacking when the construction began. Some suffered heavy impacts in these areas before fish were discovered.

Design changes during construction require immediate decisions and the need for detailed resource information cannot be overemphasized. In spite of much discussion about the pending development on PET-4, the Arctic National Wildlife Range, and elsewhere on the tundra, I feel that little serious data gathering has been accomplished. Land-use plans will not protect the fish and wildlife resources at this time. The availability of detailed site-specific information is our only assurance that development projects can be properly designed.

I am very much disturbed to see the resource agencies moving further and further apart. Relatively few years ago, I saw agency cooperation at its finest, when all seemed to have common sense of urgency because of the pending oil development on the Arctic Slope. Personnel and research funds were shared freely and vast quantities of critical information were gathered in a short time.

Now I see these same agencies fighting for individual control of d-2 lands, PET-4, and OSC programs, instead of cooperating to preserve resource options for the future. As I mentioned earlier, only token input has been made thus far on PET-4 data collection and in my opinion cooperative efforts in management of d-2 lands are marginal. I've seen battles between State and Federal governments over fish-stream jurisdiction during the trans-Alaska pipeline construction while spawning migrations were being delayed. I've seen agencies and local governments going in opposite directions in regard to reindeer industry development on the Arctic Slope. Each of these issues could have far-reaching impacts on fish and wildlife populations.

That's enough of my soap-boxing. I could tell you more about special impacts related to surface protection that we encountered during construction of the trans-Alaska pipeline. I think, however, for the sake of time, that we might open the discussion for any questions you may have.

Session 5 Discussion

MR. JERRY BROSSIA (DEC): Do you have any estimates as to the number of [peregrinc falcon] nest sites before the pipeline construction as opposed to now?

MR. HEMMING: The number of nest sites estimated at Sagwon was no greater than three. That was based on all the information available at the time construction began. There probably were only two nest sites there, however. Up to five nest sites were in the Franklin Bluffs area. Last year at Sagwon we had one active nest, which failed. Eggs were laid but failed to hatch. There were two active nests at Franklin Bluffs, and young were produced in both.

An interesting point to be made here is that even though the numbers of peregrine falcons on the Sagavanirktok River are low, they represent approximately 20 percent of the nesting population of arctic peregrine falcons in Alaska. That is very significant. The peregrine falcon still is declining, and we may not be able to do much here to prevent that, except to protect nesting habitat. Most of the problem is still from chlorinated hydrocarbons affecting egg survival. A year ago we collected eggs from a nest in which the young did not hatch. We sent them to the Patuxent Research Laboratory and the results we got this spring showed that chlorinated hydrocarbons were high enough to have prevented the eggs from hatching.

MR. BROSSIA: You mentioned siltation problems. I wonder what your major problems were.

MR. HEMMING: Siltation problems occurred basically wherever people worked in water. This is inevitable. The places where we had heavy impacts were where unexpected loads of silt entered streams. Some problems a year ago came from silts from the fuel gasline work pad that was used a little too late into breakup. Breakup occurred while equipment was still working and it had to be moved off the pad.

In a few places where drainage structures failed or where sheet flow was concentrated, massive erosion was initiated but the measurement of the impact of these silt loads on these systems cannot be evaluated at this time. Only one study that I am aware of evaluates the downstream effects of siltation on some of these aquatic systems.

Our team was set up to monitor activities within the pipeline corridor with no capability for measuring downstream impact. We merely documented the heavy silt loads as they occurred.

MR. BOB WIENHOLD: Don, do you have any evidence on revegetated material sites where the natural vegetation is re-invading or the reverse--where the material planted on the sites is displacing the adjacent natural vegetation?

MR. KEYES: In 1970 the haul road from Livengood to Yukon was constructed and the surface material that was excavated for that type construction was placed along the road as a continuous berm. It was seeded with a mixture of annuals and perennials to control erosion. Within the last five years, the willows have grown thick, over 10 feet tall. I'd classify that as an invasion of the natural because they weren't planted. They are being used by moose. The plants that were put on for erosion control, including oats, which was only an annual, and the perennials, came up the second year. They were not as vigorous because I believe the available nutrients ended up in the oat straw and the perennials were then starved for that nutrient which they needed to grow vigorously.

This is one of the fallacies of a single-application of fertilizer. There should be multiple applications if you want to help the perennials establish a firm hold. As far as the planted perennials invading the natural environment, I know of no incidents where this has occurred.

MR. TILESTON: Don, Jim gave us his recommendation on one specific change. From the standpoint of engineering, if

you were looking at a TAPS-type project again, what would you change?

MR. KEYES: I would have to say that rather than change one stipulation, I would change quite a few. I tried to make the point earlier that they should be changed to be specific as to what the permittee can and can not do. Speaking as a monitor who is supposed to enforce the stipulations I ask that you don't give these poor people some statement in the stipulations which says "Thou shalt not," such as, "Thou shalt not silt the stream." Be more specific and state what the contractor may do, so that he can better plan his operation and accomplish it in a more efficient, more cost-sensitive way.

As Jim recommended, please be more specific in your initial evaluations, so that we don't need to change the rules of the game as we go along. No contractor can plan for that, and that has certainly happened on this job.

MR. PHIL JOHNSON: Mr. Hemming, you mentioned oil spills at all the camps. The impression I have is that most of the spills occurred in the early construction of the camps where they buried a threaded pipe and then they later went to a heavier pipe as well as welded joints. I wonder if you could differentiate between the effectiveness of the two oil piping systems and whether or not a better system would solve most of these camp problems.

MR. HEMMING: I think there's no question that a great deal has been learned about how to construct and operate camps in the Arctic. Originally, threaded pipe joints were used for intracamp facilities. The threaded joints failed because of frost action, and often, fuel spills occurred within the camp pads. The spilled oil later bled out each year. At some locations such as Happy Valley, oil has been leaching out of the camp pad each summer for the past four years.

They went to a welded joint fitting and also installed utilidor-type units above ground so that fuel lines could be more easily checked. Camp fuel supply gauges were also used so they could measure fuel-in and fuel-out. If there were any changes in fuel consumption, they could start looking for spills. There's been an awful lot of change there.

One of the earliest camp fuel handling problems was that fuel storage areas were not properly lined. Fortunately, we no longer have a shortage of impervious liners.

Even though there have been improvements, accidents with fuel continue. Wherever you have a concentration of people you will have spills. We had four spills last week from various causes on the pipeline, some of which were fairly large. It just tends to become a way of life. I put oil spills in the category of a chronic problem. We have had many spills from fuel trucks hauling on the road. At the fuel storage sites, people get careless about shutting off the spigots at times. Human error is a major problem.

Temporary storage of fuel drums has also resulted in fuel spills.

The state-of-the art in fuel handling has shown vast improvement but we still recommend strongly that adequate buffers be provided so that in the event of contingencies which are still occurring we have some cushion to provide protection to aquatic systems.

MR. JOHNSON: You still would recommend 1,500-foot buffers for the streams?

MR. HEMMING: Yes, certainly. We usually have no way of finding or containing oil spills before they reach the stream with no more than a 300-foot buffer.

MR. GRUNDY: I noticed when you showed the slides of the material sites, I think they were in the Sag River, some are quite deep and full of water. My question is: Was that done intentionally or was it a problem with trying to establish the elevation distance during the winter months? If it was designed to be above water, would you have any recommendations on how to handle these material sites in active flood plains in the future?

MR. KEYES: Plans for the material sites on the Sag River had a restriction to mine above the water table. That would mean the water table at the time they were operating. If they operated in a dry season when the Sag River was at a minimal flow, then at flood stage these were inundated and became ponds. Of course, you can excavate up to 10-feet of gravel off some of these higher gravel bars. On the Dietrich River we excavated a deep hole to determine if it would be a suitable habitat for fish. Whether it's successful hasn't been established but it appears that it might be all right.

My recommendation for mining gravel in river flood plains on the Arctic Slope is that you extract thin layers

of material from exposed, unvegetated gravel bars, in a manner and at a time so that you do not contribute siltation to the stream. Stockpile the material if you have to for use later. This can, I think, result in a most acceptable end result because the reshifting of the mineral material in the spring flood breakup will usually obliterate all signs that you were there. I think you can take a large amount of gravel out of these expansive flood plains before you affect the total elevation of the stream. That's my recommendation - not a biologist's recommendation, but an engineer's.

MR. GRUNDY: Let me expand on that. Was part of the problem compounded by having these berms around the site that concentrated the equipment in a specified area instead of starting, let's say, at the toe of the bar, at the ice level and scraping in?

MR. KEYES: Yes, we tried to minimize the area that was disturbed by the contractor, and we also got him out of those exposed gravel bars. I think that on vegetated gravel bars, the surface fine-grain material that was unsuitable for use in construction had to be removed and stockpiled. A lot of these stockpiles are still on the flood plains. They will contribute silt back to the system as they are eroded by high water or rainwater. If you take gravel from exposed unvegetated bars, silt won't affect content in the stream bottom.

And yes, starting at the downstream toe of the gravel bar and skimming off a thin layer, in my opinion, will have the least effect on the hydraulics of that stream.

MR. HEMMING: If I might offer a comment, Scott. You mentioned dikes in particular. I think the use of dikes is a site-specific characteristic. On some sites it would be very desirable to have dikes, specifically, when you're concerned about fairly short-term changes in water level. At other time, dikes may not be necessary at all. I would agree that we should look at each material site on its own merits for a very specific plan rather than categorize whether or not we should have dikes.

MR. KEYES: I would like to add that I think the experience that has been gained on this project can be applied to the next one and result in a lot better job in the design/review phase than was done on our first job. That's what is important - to get the proper implementation into the design phase so that the permittee can plan for it

and understand the conditions he is going to operate under and conditions that we can enforce.

MR. FERRIANS: I have a question for Don Keyes. We've had some very interesting comments about the snow and ice road work pads for the trans-Alaska pipeline. I am sure he is aware that Arctic Gas has proposed using winter construction procedures for constructing their pipeline. They have been criticized at almost all levels by many different people as to their proposal. What is your opinion on this proposal?

MR. KEYES: I think the only constraint on snow pads is that you have a limited construction season. You can perform all necessary activities on a snow pad to get a pipeline constructed. You can construct it and get off the snow pad before breakup and surface disturbance that will cause you problems in the future will be minimal.

I think the problem has been that people using snow pads do not recognize that they will not carry into summer. You've got to get off them when they start breaking up in the spring. The time to get off is when the wheel load breaks down the structure of the snow pad.

Alyeska made a mistake last year when they tried to place backfill bedding material on a pad and blade it into the ditch as a backfill technique. They didn't get it all into the ditch. Too much snow was mixed with it. When spring came and the snow started to melt, the spoil waste that they hadn't cleaned up showed up on the surface, leaving large amounts of silt exposed to erosion. The backfilled ditch ended up with cavities when the snow that was in the ditch melted. A second attempt was made to get the ditch backfilled properly. This year no gravel or dirt was placed on the snow pad. It was backfilled directly into the ditch using the elephant's trunk. There is no erosion potential from that activity this year. One mistake was that they excavated the trench in fine-grain material. It was spread on the road surface and the Highway Department thought it would be a good binder to mix for the surface of the haul road. Because the gravel was too clean, it would not support the traffic and it became washboard. They thought fines would be a good asset to have on the surface of the haul road. The problem was that breakup came and the snow melted from the surface of the road, carrying that silt down off the toe of the road and into the vegetation next to it. If either the snow had been bladed off so it wouldn't

be subject to erosion, or the material mixed into the surface before breakup, the attempt would have succeeded.

I think we learned something on the snow-pad construction last year. I think the snow pad used for the 48-inch pipeline construction is a good example.

MR. HEMMING: Just one comment on snow-pad construction. It's really a word of caution. This year there were good successes with the use of snow pads on the Arctic Coastal Plain. But we also had a much greater natural accumulation of snow than I've seen in my experience working up there for many years. I think that the state of the art is very thin. We don't know a lot yet about the use of snow roads. I think we should be very careful, make sure we know something about the natural distribution and abundance of snow and other things before we make any dramatic conclusions on their advantages or disadvantages.

MR. Karl FRANCIS: I have a question for Don. I'd like to know a little more about your experience with snow making. In the picture I notice there appears to be some vaporization. I wonder at what temperatures you observed that type of snow. Did you notice that there was any significant loss as to how snow is produced as opposed to when the snow is vaporized? Did you notice any particular losses when the temperatures went down as opposed to vaporization?

MR. KEYES: I have not observed the phenomena that you're asking me to judge. I will say that snow making is expensive. I don't think it's the answer to building extensive snow pads. I think you can use it at specific sites for very small areas. Another source of snow is to remove ice from lakes adjacent to the area and pulverize it to build the snow pad. That water source is much more suitable. It has no fog to be concerned about. It's just a matter of going out and mining ice from the surface of a lake, hauling it, and using it for building snow pads, filling in holes, or whatever you need the snow for.

I think that technique will prove in the future to be a better alternative. I think Jim made the statement that some of the snow-pad techniques are still in the initial phases, but if we don't go out and do something we'll never learn how we should not have done it or how we should do it. I think we have enough experience now since they've used snow roads, snow pads since in the 1950's when the White Alice sites were constructed for military use. Miners have

used snow roads and snow pads. I think mobilization of the Hickel Highway was a success, recognizing that in 500 to 600 miles of road they had erosion problems in very few places - and yet very little control was on that activity at the time. The situation was pretty much that they hired a maintenance man, and he made the decisions as he went along. I think with the proper controls, snow pads and ice roads will prove totally environmentally acceptable as well as engineeringly and structurally acceptable.

MR. FRANCIS: Let me clarify the basis of my questions. We've had some reservations in regard to the manufacture of snow. We've done considerable research on the use of granulated ice and snow roads which will be reported this afternoon. But I was curious to know if you've had better success with your snow manufacturing than we think. It seemed to me that in your statement you indicated you manufactured snow as an adequate source, at least for the purposes it was being used there. I just wondered if you encountered any problem at extreme low temperatures.

MR. KEYES: I don't think Alyeska attempted it in very cold temperatures. I think it was relatively warmer when they were doing that, so I don't think we have the experience to judge low temperature manufacture of snow.

MR. JOHNSON: I'd like to point out that Alyeska did manufacture snow at very low temperatures at the Chatanika River almost two years ago.

MR. RUSS SOULEN: Oscar Ferrians raised one of the persistent questions dealing with the three proposals to move the natural gas from Prudhoe Bay. That was the question about the efficacy of snow roads and so forth. Another question that has come up persistently deals with winter productivity. How good is current technology in terms of machinery and what not? Most of the testimony and argument I have heard says that at about minus 35 degrees, the curve on machinery breakdown starts up very rapidly and the curve for work and productivity starts plunging very rapidly. Yet in your presentation you mentioned - I believe it was the gas fuel line construction - that part went along at a pretty good clip at minus 50°F. Would you care to comment on this question?

MR. KEYES: Yes, I would like to comment further on that. It has been a very serious question. The point that I would like to make is that almost all activities necessary to build that gas line were conducted in an artificial

environment. Tractor operators had head shrouds, all heated cabs, the welders were in heated shelters, and there was a minimal amount of activity with people standing out in the cold. This can be done on a larger pipeline just as easily as on a 10-inch. Construction equipment requires maintenance at cold temperatures but it might be cheaper to maintain a little more equipment than to try to build an extensive gravel pad as Alyeska did. The trade-off, both in dollars for the company and environmentally for the land, should be considered seriously.

MR. SOULEN: But it would seem to me that if we can assume the TAPS experience has been the highlight, and with the highlight of yet another experience with the gas yet to come, and the potential for yet more construction in the arctic environment, wouldn't it be logical to assume that this may lead to a whole new technology in terms of esoteric equipment to do specialized work in the Arctic Slope?

MR. KEYES: I hope it does, because I think you realize as I do, that all equipment used on this project is off-the-shelf standard equipment brought right out by the manufacturer. There's been no use of special type metals, special type developmental equipment of any kind. It's really just a makeshift operation out on the field. You cope with the conditions. We should expect more success with future-developed machines, equipment, and materials suited to minus 50°F temperatures.

MR. TILESTON: This discussion is exactly the type we're looking for. There was one question I'd like for Don Keyes to expand on a little further. One of the major issues we were bouncing around in half a dozen different ways was gravel availability and consumption. Don talked about the technique of using insulation on top of the tundra as a method for reducing the amount of gravel required for certain functions. I'd like to address that a little more and have some additional questions on that area. I think it's very important to begin to think about that.

MR. KEYES: In engineering terms you can place a 5-foot thick gravel pad on the tundra. It will actually cause the permafrost to agrade (to move up) into the gravel pad and that provides a very stable foundation for this gravel roadway. Gravel is not a good insulator. I like to think in terms of it being a heat-sink. You people who work out in the field in the summertime when it's hot take your thermos bottle with you and place ice cubes in it to keep your drinks cool. If you put enough ice cubes in your drink

or in your thermos bottle, by lunch time the water is still cool. A gravel road is that same concept. The moisture and your specific heat of gravel super-cools through the winter months. When spring comes, the sun starts warming the gravel pad, melting from the surface down. The object is to have enough ice so that the active layers stops by fall before it reaches the ice-rich permafrost below.

This is great along the Sagavanirktok River where people think we have an unlimited supply of gravel. It may be unlimited for the first pipeline, but for the second, third, fourth, or fifth pipeline (and there will be five or more), we may run short of gravel along the Sag River. It is not an unlimited resource.

As a rule of thumb on the Arctic Slope, you can reduce the gravel layer and put in an insulation layer. This is a completely different system. The insulation layer now controls heat transfer to the underlying permafrost. It is not a heat sink. The surface gravel must be between 18 and 24 inches thick so the wheel load pressure is distributed and the insulation will hold up without crushing. The insulation is placed under the gravel to control the heat transfer into the permafrost and prevent melting and causing the road to fail.

You want to keep that permafrost frozen and solid. You can remove a foot of gravel and replace it with one to two inches of insulation. That's your trade-off. Five feet of gravel on the Arctic Slope can be reduced to two feet if you put in three to four inches of insulation. This thermally designed roadbed can survive the Alaskan Arctic Slope summer.

The questions is, what's the gravel worth and what's the insulation worth in terms of dollars to the permittee or in terms of resources value to the government or the people? There is going to be a trade-off. There are places where Alyeska had to use the insulation because there wasn't enough gravel within a reasonable haul distance. I'm talking in terms of hauling the gravel 30 miles. They're hauling riprap right now 140 miles on the Arctic Slope. Gravel resources were almost depleted on the route between Toolik and the Sag River. Very little gravel is left, even though they used insulation to reduce its use to a minimum.

There will be a time when we will no longer be able to use gravel. We will have to use snow pads. It will not be a choice--we will have to do it. Why don't we start right now?

Geological Data Requirements

for efficient surface protection in the Arctic Foothills and Arctic Plain Physiographic Provinces

Oscar J. Ferrians, Jr.*

ABSTRACT
Surface management would be a more appropriate term for this discussion than surface protection. A great deal must be known about an area before guidelines and stipulations are made for its protection. Mineral and petroleum resource potential should be learned before special land-use areas are determined; and surficial and other geologic maps provide those who work in an area with the data they need. Specific geologic considerations for land and surface managers in arctic areas include permafrost, slope characteristics, geologic hazards, erosion, river icings, mudflows, and areas of ice-wedge polygons. Suitable arctic construction techniques include preserving the vegetation mat over permafrost and placing structures on piles.

Our panel this morning treats geology, soils, and vegetation. There is a common thread throughout this discussion that must be considered. We must know a lot about the physical characteristics of an area before we can make intelligent guidelines, rules, or stipulations. Before I start my discussion about geology I want to make a statement, somewhat philosophical in nature, on a point which I think is quite serious.

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There seems to be an attitude involved in formulating rules and guidelines that I think is a little in error. I think it even goes to the title of this symposium. We're talking about surface protection; I wonder if we really mean "protection." I took the trouble of walking a mile this morning to get a dictionary to look for the definition of "protection." The first definition I found is: "to cover or shield from injury or destruction." The second definition is: "to shield or foster by a protective tariff." A synonym is "to defend" and an antonym is "to attack."

I think it would be better if we were to think in terms of surface management. I believe this is what we are really after, management. It instills a little different concept and attitude on our part if we think of managing rather than protecting or defending. In some cases, maybe a surface does not have to be defended or protected to a degree we're thinking about here.

Now back to what I think about most--geology. Geology is fundamental to all the things we are trying to do here. One of the most important tasks at the very beginning of any of these operations is to determine what the potentials are for mineral, oil, and gas resources in an area. If we do not know this, it is extremely difficult to come up with intelligent rules and regulations and proper management of any area.

We have an ironic situation now where large areas within a petroleum reserve, the Naval Petroleum Reserve No. 4, have relatively little potential for oil and gas. Conversely, within the Arctic National Wildlife Range there are areas that have extremely high potential for oil and gas. In fact, you can go out with a jar and pick up crude oil along the beach near Barter Island.

This tells me that perhaps the boundaries are not drawn in the right place. Perhaps there are better ways of determining proper land use in the Arctic, in dividing up the area to accomplish our overall objective for the national interest in terms of wildlife and natural resources.

I'd like to itemize some more specific things in terms of management and go through a series of slides.* I'll elaborate on some of them and show examples of some of the specific geologic factors that are critical for determining proper surface management and land use.

*Printing limitations prevented reproduction of color slides shown by Mr. Ferrians during his symposium presentation.

One of the items that I feel is fundamental is a surficial/engineering geologic map of an area. These maps provide many data that are invaluable to archeologists, botanists, engineers, and anyone else who is working in the area.

Geology is the study of the soil and rocks; it's fundamental. An engineering geologic map can show many important factors, including the character and distribution of surficial material and bedrock. For many reasons we need information about the distribution of sand, gravel, and riprap, especially for construction purposes. Much damage has been done to the environment because people didn't know where there were adequate sources of borrow material for construction. Different types of soil respond differently to surface activities, and this should be known in quite a bit of detail.

In the north country, permafrost is of paramount importance. It transcends all of the other disciplines. We need to know the character and distribution of permafrost, especially ice-rich permafrost which poses most of the engineering problems.

Character of slopes is another critical item that sometimes doesn't receive the attention it should. This is especially important where we have both ice-rich permafrost and steep slopes. A multitude of problems can develop in these environments.

Geologic hazards--that's sort of a catchall term that covers many important things that need to be considered. Among them are thawing of ice-rich permafrost, seismicity, liquefaction of soils, active faults, unstable slopes, solifluction, swelling ground, accelerated erosion, flooding, icings, and similar items.

I would like to show you a series of slides and elaborate a little on these geological factors.

On the coastline on the Arctic Slope, normally the freeboard or sea-cliff is quite low, less than three meters but occasionally as much as four or five meters. We call this a low-energy coastline because the tides are normally less than a foot. Occasionally, in the summertime, storms generate a lot of wave activity and water does extend for great distances back on the shore because of the low freeboard. A tremendous amount of erosion occurs during these storm intervals. During most of the summer the coast is

quite static and in the winter it's even more static. But in the summertime, the permafrost, the ice-rich soils, thaw continuously. When the occasional storm comes along, a tremendous amount of thawed material is removed in a very short time. The average recession is about a meter a year.

This large river icing is along the Canning River of the Arctic Slope. It is about a mile wide and provides unusual engineering problems. Anyone who plans to operate in this area must allow for this type of phenomenon.

This is a ground view of a river icing that persists the year around.

Here is a good view from the air of ice-wedge polygons. Thousands of square miles of the Arctic Slope are underlain by a honeycomblike network of ice-wedge polygons. Where trenching has taken place in these areas, as much as 85 percent of the exposed trench has been ice. It is easy to understand what the problems would be if you buried a heated oil pipeline in ice-rich soil like this. It would cause rapid thawing of the ice and flowage of the soil.

This is a typical view of a single ice wedge across that section and there's a carrotlike shape. Normally, the views are not like this. The active layer on the Arctic Slope is quite thin; that's the part above the ice wedge. This part freezes and thaws annually. Normally, the active layer is 12-18 inches thick in environments like this. When you get into the gravelly soil, the active layer is much thicker.

This is a more typical view of ice-rich, fine-grained soil on one of the rivers on the Arctic Slope. Ice wedges are exposed in an undercut riverbank. The view, along the Sagavanirktok River, shows a recession of the high banks along the river caused by thawing of the ice-rich permafrost soils.

This is a very large mudflow, a landslide-type feature on the Arctic Slope in the foothills region. It is caused by permafrost thawing. Mother Nature did this, but if man disturbs the surface in these areas, he could also initiate this type of mudflow-landslide feature.

This is the headwall of that last feature we saw. You can see that it is actively retreating. This retreat goes on until a point of equilibrium is met and then the thawing stops and Mother Nature tends to heal over the scar.

These are thawed ice-wedge polygons near the coast. You can see the depressions. The depression is about four feet deep where the man is standing. The center of the polygon has not thawed, and so we do not have the settlement that has occurred over the ice wedge itself.

This is a typical seismic trail near Sagwon. The trench is about five feet deep. It was caused when the bulldozer operator dropped the blade and removed the vegetation mat, disturbing the thermal regime of the permafrost. This in turn caused thawing of the permafrost, thickening of the active layer. Consequently we have a five-foot deep trench across this hillside. In low-lying areas where there is water, you have drainage problems. I have several more examples of old seismic trails to show.

This is a seismic trail near the Canning River on the Arctic Slope. You can see how the water is ponded along the trail. The amount of differential settlement is greater than five feet on this particular stretch.

This is a view of a seismic trail on a slope. Accelerated erosion has cut a gully here that is over 15 feet deep. You can see the ice exposed in this trench. The shovel is about two feet high and provides scale.

This is another trail in the Prudhoe Bay area--it looks like a canal now.

This Rolligon-type vehicle mired down and became stuck on the tundra near Prudhoe Bay. Contrary to what is said, they don't always go everywhere.

This is a good example of how roads should be constructed on the Arctic Slope. It's constructed with about five feet of gravel fill. This provides enough insulation so that the permafrost table is not lowered.

This is an example of how buildings should be constructed. They've used wooden piles in this case, providing considerable air-space under the building so that the heat can leave the building. If the building had been placed on the ground surface, the heat from the building eventually would reach the permafrost and cause extensive thawing which would then cause structural problems. This way the piles are imbedded in the permafrost and they freeze in just as in concrete and provide a stable foundation.

In closing I'd like to emphasize that I think our role should be to manage these arctic areas. I believe that when we talk about "managing," things are placed in proper perspective.

The other point I would like to emphasize is that there is a tremendous need to obtain baseline data on these areas before stipulations and guidelines are prepared. If we write rules and regulations when we are ignorant of what is really there, we can make many mistakes. Whenever possible, every effort should be made to collect as many baseline data as possible on all aspects of the environment.

Soils and Vegetation of the Arctic Slope of Alaska–

An Interim Report

William R. Fibich*

ABSTRACT
The Exploratory Soil Survey of Alaska was initiated in 1967 and completed in 1973. Information from the survey will be published in 1977. Existing maps and literature were used, but the exploratory soil map was based largely on observations and soil sampling done from a helicopter, which could land frequently in wilderness areas. On the Arctic Slope, the major land resource areas are the Brooks Range, the Arctic Foothills, and the Arctic Coastal Plains. Most Arctic Slope soils have permafrost within two feet of the surface, are composed of fine silt material, and are insulated with a surface layer of organic matter. Satellite imagery was used in a recent soil and vegetation inventory on the Seward Peninsula. This method is likely to be used more in future inventories.

The earliest soil surveys in Alaska were made in 1914 by the Department of Agriculture as part of the study of

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*Mr. Fibich is Assistant State Soil Scientist, Soil Conservation Service, USDA, Anchorage, Alaska. Much of this report is taken from the report, Exploratory Soil Survey of Alaska, 1976, by Samuel Rieger, Dale B. Schoephorster, and Clarence E. Furbush, soil scientists with the Soil Conservation Service, U. S. Department of Agriculture.

possible routes for the Alaska Railroad, and by the Bureau of Soils in 1916 for the purpose of studying the soils, agriculture, and other resources and the general economic conditions within and adjacent to the Chugach National Forest. A number of other soil surveys were made by the Department of Agriculture throughout the years. Despite these activities, it has long been apparent that only a general small-scale survey could provide soils information needed for wise and efficient land-use planning throughout the State within a reasonable time.

The Exploratory Soil Survey of Alaska was initiated in 1967 to meet this need. It was completed in 1973. Field mapping was on a scale of 1:500,000, about eight miles to the inch. All existing soil maps and reports were utilized, but the exploratory soil map was based largely on observations made from a small helicopter which could land frequently in wilderness areas.

In the survey, distinctive landscape patterns were identified from the air and delineated on the map. Soils within each landscape segment were described and classified. Relationships between the soils, native vegetation, and land forms were noted. The proportion of the area occupied by each particular kind of soil was estimated. In essence, each mapping unit in the Exploratory Soil Survey consists of an association of soils arranged in a consistent pattern. Individual soil boundaries, however, are not shown.

The suitability of these soils for various uses was determined on a basis of appropriate soil properties.

This presentation is concerned with the part of the Alaska Exploratory Soil Survey that covers the Arctic Slope. The major land resource areas which comprise the Arctic Slope of Alaska are the Brooks Range, the Arctic Foothills, and the Arctic Coastal Plain. These areas extend to Canada on the east and to the Chukchi Sea on the west. During the Exploratory Soil Survey, soils and vegetation of the area were inventoried.

On the soil map the different soils are separated and given names. Their properties are all described in detail, and each kind of soil is assigned a mapping unit symbol. The names given the soils are from the soil classification system that is used in the Soil Conservation Service.

Table 1 shows the acreage of the mapping units of major land resource areas.

Table 1. Major Land Resource Areas and Their Estimated Extent.

Major land resource area	Estimated extent		
	Land (Acres)	Water (Acres)	Total (Acres)
Southern Alaska			
Southeastern Alaska	18,743,000	8,000	18,751,000
Southcentral Alaska Mountains	30,043,000	134,000	30,177,000
Cook Inlet-Susitna Lowland	7,333,000	222,000	7,555,000
Alaska Peninsula and Southwestern Islands	22,653,000	816,000	23,469,000
Interior Alaska			
Copper River Plateau	8,999,000	369,000	9,368,000
Alaska Range	18,962,000	12,000	18,974,000
Interior Alaska Lowlands	30,559,000	2,268,000	32,827,000
(Koyukuk-Innoko Lowland)	(8,760,000)	(887,000)	(9,647,000)
(Kanuti Flats)	(1,129,000)	(44,000)	(1,173,000)
(Tanana-Kuskokwim Lowland)	(12,238,000)	(804,000)	(13,042,000)
(Yukon Flats)	(8,432,000)	(533,000)	(8,965,000)
Kuskokwim Highlands	46,826,000	911,000	47,737,000
Interior Alaska Highlands	53,435,000	318,000	53,753,000
Arctic and Western Alaska			
Norton Sound Highlands	30,930,000	413,000	31,343,000
Western Alaska Coastal Plains and Deltas	18,434,000	4,263,000	22,697,000
(Selawik-Kobuk Delta)	(1,787,000)	(401,000)	(2,188,000)
(Yukon-Kuskokwim Delta)	(10,300,000)	(2,926,000)	(13,226,000)

(Continued on next page.)

Table 1, continued.

Major land resource area	Estimated extent Land (Acres)	Water (Acres)	Total (Acres)
(Bristol Bay Coastal Plain)	(6,347,000)	(936,000)	(7,283,000)
Bering Sea Islands	2,629,000	217,000	2,846,000
Brooks Range*	29,159,000	192,000	29,351,000
Arctic Foothills*	31,488,000	135,000	31,623,000
Arctic Coastal Plain*	12,323,000	2,510,000	14,833,000
Total	362,516,000	12,788,000	375,304,000

*Arctic Slope.

Each of the major land resource areas of the Arctic Slope is described below.

The Brooks Range, the northern extension of the Rocky Mountains, extends across northern Alaska from the Canada border almost to the Chukchi Sea. The highest part of the Range, in the east, has been subject to intense glaciation and is very rugged. The lower western section has smoother, less precipitous slopes though most of it, too, was formerly covered by glaciers.

The southern slopes of the Brooks Range mark the northern limit of extensive forests in Alaska. A few patches of forest, however, occur at lower elevations within the range. Alpine tundra covers intermediate slopes; and higher areas have essentially no vegetation.

In all but the southern slopes of the Range, the climate is arctic. In most years, freezing temperatures occur every month. Total precipitation is low, but the number of days with some precipitation is high. Heaviest precipitation is on the southern slopes, where the climate is much like that of the Interior Highlands, and near the summits. The lowest rates occur on the northern slopes. Winds are frequent and strong, especially at the mountain crests.

The population is very low. The village of Anaktuvuk Pass is the only permanent settlement. Subsistence hunting is the chief means of livelihood for the permanent residents.

The Arctic Foothills is an area of low ridges and intervening swales north and west of the Brooks Range. The elevation is generally less than 2,000 feet (600 m), although some hills close to the Range are as high as 3,500 feet (1,050 m). Except in places immediately north of the Range, the area has never been covered by glaciers.

The vegetation over most of the area is treeless tundra. Forests of white spruce, paper birch, and black spruce occur only in the Noatak Valley north of Kotzebue Sound. Permafrost underlies virtually the entire area.

The area has an arctic climate, modified slightly in the western portion by maritime influence. Mean annual temperatures everywhere are very low, and frosts may occur in any month. Extremes of temperature in both winter and summer are greater in the area north of the Brooks Range

than in the western foothills. Precipitation is very low north of the Brooks Range and only slightly higher in the west, but there are many cloudy days with light rain or snow. High winds occur in winter.

The area is very sparsely populated, with most permanent residents in the southwestern section. Subsistence fishing and hunting are the principal means of livelihood. Reindeer herds have some importance in the southwestern part of the area. There is no farming, and the small timber resource has not been exploited.

The Arctic Coastal Plain is a gently rolling treeless area with many shallow elongated lakes and naturally drained lake basins. Rivers flowing from the mountains and foothills to the south meander across the plain to the Arctic Ocean. Sand dunes occur along rivers in the central part of the area and near the coast.

The vegetation is tundra, consisting of sedges, mosses, low-growing shrubs, and associated plants. Polygonal ground patterns are well developed. The entire area is underlain by permafrost.

The climate is typically arctic, with very low mean annual temperatures and very low precipitation rates. Freezing temperatures may occur in any month. Strong winds are common in winter.

Permanent residents are few and are concentrated in a few settlements along the Arctic Coast. A number of other temporary residents are employed in various government projects and in oil and gas production. Subsistence hunting and fishing are important in the economy.

The Soil Classification System

The Soil Taxonomy of the National Cooperative Soil Survey adopted in 1965 after a lengthy trial period, differs from earlier soil classifications in that classes are defined exclusively by properties of the soils themselves rather than external features such as climate and vegetation. It is recognized, however, that the kind of soil that forms at any point reflects these environmental factors.

The properties that have been selected as criteria for classification at the higher levels of the taxonomy are largely those that result from soil-forming processes influenced by the environment, but they are defined in

terms of measurable soil characteristics. These are mainly characteristics that can be readily determined in the field, such as color or consistence, but many are properties that can be determined only by laboratory analysis or by repeated measurements over a period of time. All soil properties used in classification are defined quantitatively.

The Taxonomy groups soils at six levels or categories. The broadest category is the order. Successively more narrowly defined categories are the suborder, the great group, the subgroup, the soil family, and the soil series. In the <u>Exploratory Soil Survey of Alaska</u>, soils are classified at the subgroup level.

A unique feature of the Taxonomy is its system of nomenclature. Each order is assigned a connotative syllable which is used as a formative element in developing the names of classes in lower categories. Five orders (of a total of ten in the complete scheme) are represented in Alaska. These orders and their formative elements are:

Entisols (formative element - ent)

Histosols (formative element - ist)

Inceptisols (formative element - ept)

Mollisols (formative element - oll)

Spodosols (formative element - od)

Names of classes in the two categories below the order are formed by connecting these formative elements with other syllables suggestive of properties that are emphasized in the Taxonomy. Thus, Inceptisols with characteristics of wetness are in the suborder of Aquepts and Histosols formed mainly from fibrous undecomposed materials are in the suborder of Fibrists. A third syllable is added to form the names of great groups. This syllable for most soils in Alaska is <u>cry</u>, to indicate low soil temperatures; i.e., Cryaquepts, Cryofibrists. Subgroup names are the great group names modified by one or more adjectives. A <u>typic</u> subgroup normally represents the central concept, though not necessarily the most extensive soils, of its great group. Other subgroups differ from the Typic in one or more respects, as indicated by the adjectival portion of the subgroup name. Pergelic Cryaquepts, for example, differ

from Typic Cryaquepts in that they have mean annual soil temperatures of 0°C (32°F) or less, hence permafrost at some depth.

Soils are made up of a sequence of layers or horizons. Many different kinds of horizons exist in soils. Some of the more common and distinctive horizons have been selected as diagnostic horizons in soil classification. In the higher categories of the Taxonomy, definitions of classes are based in large part on the presence, alone or in certain combinations, or absence of these horizons. They are in the two groups, diagnostic surface horizons (epipedons) and diagnostic subsurface horizons.

Mapping Units

Mapping units in the Exploratory Survey are associations of phases of soil subgroups. The phases are of two kinds, topographic and textural. Soils, except for Histosols, are identified as either nearly level to rolling (slope gradients dominantly less than 12 percent) or hilly to steep (slope gradients steeper than 12 percent), and are classified into one of four textural groups--clayey, loamy, sandy, or very gravelly. The textural classification applies, in most cases, to the portions of the pedon between depths of 10 and 40 inches, or between 10 inches and consolidated bedrock shallower than 40 inches. Where bedrock is shallower than 14 inches, it applies to all of the soil above the rock. In soils that are perennially frozen about 40 inches, it applies to the soil above the frozen layer and to the upper 10 inches of the permafrost. In soils with contrasting textures within these limits, the dominant texture is used. Sandy soils are those in which, within these depths, at least 70 percent by weight of the mineral soil passing through a 3 mm screen consists of particles coarser than 0.1 mm in diameter (larger percentages are required if clay is present). Clayey soils are those which contain more than 35 percent by weight of particles finer than 0.002 mm. All others, except the very gravelly soils, are classified as loamy. Very gravelly soils are those in which particles coarser than 2 mm make up at least 35 percent of the soil volume, regardless of the composition of the finer material.

In essence, each mapping unit or soil association consists of segments of the landscape with a distinctive topographic and soil pattern. Virtually all of these landscape segments contain soils representative of several subgroups, and many include soils of both topographic phases

and two or more of the textural phases. Each mapping unit is named for the one or two most extensive phases of subgroups included in it. The less extensive soils within a mapping unit are not identified in its name, but are noted in the description of the unit. The acreage of the mapping units in each of the major land resource areas of the Arctic Slope is given in Table 2. The names of the mapping units and the percentage of soils on the Arctic Slope are shown in Table 3. For detailed descriptions of the mapping units, one must refer to the edited Exploratory Soil Survey of Alaska which is scheduled for publication this year.

Histic Pergelic Cryaquepts, nearly level to rolling, loamy - These are poorly drained soils that occupy broad sloping valleys, nearly level basins, low piedmont hills, and the low portions of mountain footslopes north of the Brooks Range. The soils are shallow over permafrost. In valley bottoms and on the lower portions of low slopes most of the soils are formed in thick deposits of nonacid silty colluvium. These soils commonly have a striped surface pattern on the slopes and a polygonal pattern on nearly level valley bottoms and basins. The soils that occupy higher slopes and low hills are commonly formed in nonacid light silty clay loam derived from fine-grained sedimentary rock.

The vegetation is tundra, dominated by sedge tussocks, mosses, lichens, and low shrubs. Beneath a thick peaty surface mat, the soils have a mottled, dark gray silt loam horizon with black streaks of frost-churned organic matter. Depth to ice-rich permafrost ranges from about 5 to 15 inches (12 to 40 cm). Immediately above the permafrost table, many of the soils have a thin layer darkened with organic materials. Some soils on low hills contain a few angular stones and pebbles.

This soil is the major component of the Arctic Foothills and the Arctic Coastal Plain. It occupies about 27 percent of the Arctic Slope.

Pergelic Cryaquepts, nearly level to rolling, loamy - These are poorly drained soils that occupy the tops of low rounded knolls and ridges. They also occur in a few flood plains. The vegetation consists of sedges, mosses, and other low tundra plants. On the crests of knolls and ridges, nonvegetated and sparsely vegetated circular frost scars make up much of the surface. Both vegetated and nonvegetated soils in this position consist of mottled, dark gray gravelly silt loam or gravelly silty clay loam

Table 2. Acreage of Mapping Units in Major Land Resource Areas of the Arctic Slope.

Mapping Unit	Brooks Range	Arctic Foothills	Arctic Coastal Plain	Total
		Thousands of Acres		
IQ2	322	15,618	-	15,940
IQ3	-	116	-	116
IQ5	330	-	-	330
IQ6	188	84	5,095	5,367
IQ7	-	902	-	902
IQ8	-	3,980	-	3,980
IQ11	-	442	-	442
IQ18	72	-	-	72
IQ20	-	518	152	670
IQ21	-	-	2,367	2,367
IQ22	72	1,338	1,265	2,675
IQ24	2,567	2,338	-	4,905
IU2	-	174	-	174
MA1	-	-	3,444	3,444
MA2	1,033	-	-	1,033
MA3	1,403	793	-	2,196
MB2	696	4,898	-	5,594
RM1	17,731	47	-	17,778
RM2	4,745	240	-	4,985
Total Land	29,159	31,488	12,323	72,970
Total Water	192	135	2,510	2,837
Total Arctic Slope	29,351	31,623	14,833	75,807

Table 3. Names of Mapping Units - Arctic Slope of Alaska and percentages of soils that occur there.

Soil Number		Description	Percentage on Arctic Slope
IA7	IQ2	Histic Pergelic Cryaquepts, nearly level to rolling, loamy	27%
IA8	IQ3	Histic Pergelic Cryaquepts and Typic Cryofluvents, nearly level, loamy	
IA9	IQ5	Histic Pergelic Cryaquepts, nearly level to rolling, loamy and Pergelic Cryorthents, hilly to steep, very gravelly	
IA11	IQ6	Histic Pergelic Cryaquepts, nearly level to rolling, loamy and Pergelic Cryofibrists	
IA12	IQ7	Histic Pergelic Cryaquepts, nearly level to rolling, loamy, and Pergelic Cryaquepts, nearly level to rolling, very gravelly	
IA13	IQ8	Histic Pergelic Cryaquepts, nearly level to rolling, loamy, and Pergelic Cryaquepts, hilly to steep	
IA15	IQ11	Histic Pergelic Cryaquepts, nearly level to moderately sloping, loamy, and Pergelic Cryumbrepts, hilly to steep, very gravelly	
IA5	IQ18	Histic Pergelic Cryaquepts and Typic Cryochrepts, hilly to steep, very gravelly	
IA26	IQ20	Pergelic Cryaquepts and Pergelic Ruptis Histic Cryaquepts, nearly level to rolling, loamy	4%
IA20	IQ21	Pergelic Cryaquepts and Pergelic Cryopsamments, nearly level to rolling, sandy	
	IQ22	Pergelic Cryaquepts, nearly level, very gravelly	
IA21	IQ24	Pergelic Cryaquepts and Pergelic Cryorthents, hilly to steep, very gravelly	
IU2	IU2	Pergelic Cryumbrepts and Histic Pergelic Cryaquepts, hilly to steep, very gravelly	

(Continued on next page.)

Table 3, continued.

Soil Number		Description	Percentage on Arctic Slope
MA3	MA1	Pergelic Cryaquolls and Histic Pergelic Cryaquepts, nearly level to rolling, loamy	
MA1	MA2	Pergelic Cryaquolls, nearly level to rolling, very gravelly	
MA2	MA3	Pergelic Cryaquolls, nearly level to rolling, very gravelly and Pergelic Cryoborolls, hilly to steep, very gravelly	6%
MB2	MB2	Pergelic Cryoborolls and Pergelic Cryaquolls, hilly to steep, very gravelly	
RM1	RM1	Rough mountainous land	
RM2	RM2	Rough mountainous land and Lithic Cryorthents, hilly to steep, very gravelly	30%
		Water	4%

weathered from fine-grained sedimentary rock. The coarse fragments are usually angular and make up about 10 to 35 percent of the soil volume. Depth to permafrost ranges from about 5 to 15 inches (12 to 40 cm) beneath a thin peaty surface mat, and about 15 to 30 inches (40 to 75 cm) in the nonvegetated frost boils. The nearly level soils on flood plains have mottled, dark gray cambic horizons developed in stratified silt and fine sand. In these soils the permafrost table is generally 20 to 40 inches (50 to 100 cm) below the surface.

This soil occupies about 4 percent of the Arctic Slope.

Pergelic Cryaquolls, nearly level to rolling, very gravelly - These poorly drained soils with shallow permafrost tables occupy broad nearly level terraces and footslopes. They are developed in nonacid and calcareous very gravelly loamy materials under a vegetative cover dominated by sedges, mosses, and low-growing shrubs. Typically, under a mat of partially decomposed organic materials, the soils have a black mucky silt loam horizon over mottled, dark gray and dark grayish brown very gravelly silt loam or sandy loam. Depth to permafrost is about 10 to 20 inches (25 to 50 cm) beneath the organic mat.

This soil occupies about 2 percent of the Arctic Slope.

Pergelic Cryoborolls, hilly to steep, very gravelly - These are well-drained very gravelly loamy soils that occur on hilly moraines and south-facing colluvial slopes. The vegetation is tundra dominated by grasses, mosses, lichens, dryas, forbs, and dwarf shrubs. Typically, under a thin peaty surface mat, the soils have a dark humus-rich nonacid or calcareous gravelly silt loam to sand loam upper layer over dark gray very gravelly sand or sandy loam. Though the mean annual soil temperature is less than 32°F (0°C), thick lenses of ice-rich permafrost seldom form in the coarse-grained materials.

This soil occupies about 4 percent of the Arctic Slope and occurs mostly in the Brooks Range and the Arctic Foothills.

It is significant that most of the Arctic Slope soils, insulated with organic matter, are composed of a fine silt material. In case the organic matter surface is destroyed by man, machines, or other means and the ice-rich permafrost exposed, these soils will flow very easily. They will liquify. We must be very concerned about damaging this protective organic mat.

Let's leave the Exploratory Soil Survey on the Arctic Slope. I'd like to spend a few moments talking about a soil survey on the Seward Peninsula. Satellite imagery was used to help us inventory the soils and vegetation of this area.

The soil and vegetation survey of reindeer range on the Seward and Baldwin Peninsulas resulted when the NANA Corporation requested assistance from the Soil Conservation Service to help plan their reindeer operation. The first objective of the survey was to make a vegetation and soil inventory of four and a half million acres; the second objective was to assist the NANA Corporation in their Reindeer Range Management Plan; the third objective was to see if satellite imagery was useful in making soil and vegetation inventories.

Each color on the satellite image indicates the kind of vegetation and soil in that area of land. A satellite image may be color-enhanced to bring out the different types of vegetation.

The satellite images are compared with the infrared maps, topographic maps, and areas of land are identified with areas on the maps. This is called field-checking of the different areas. Notice the vegetation here--on the Seward Peninsula it's similar to that on the Arctic Slope.

When a large enough area of uniform vegetation and soil is located, and the satellite image also shows uniform color, the site may be selected for further investigation. Helicopters were used for transportation. All equipment was tied to the helicopter.

During on-the-ground surveys, species of plants are identified and weight samples of each are taken. Soil samples are taken and correlated with vegetation samples.

Detailed vegetation and soil facts are recorded for future use in planning and evaluating the resource data.

If you have any questions I'll be happy to answer them.

MR. BOB GAL: My question is: How were your data obtained for the Arctic Slope? How were the data obtained in creating the soil map? I'm thinking in terms of how sure I can be in applying it. What kind of sampling program did you use? How many sections roughly were drawn?

Another question is: Do you have a measure of the accuracy of that map that you produced?

MR. FIBICH: Do you mean on the Arctic Slope?

MR. GAL: Right.

MR. FIBICH: Most of the work was done by flying over a particular area that has similar type topography and the same kinds of peculiarities. Then men on the ground examine the soil. A lot of areas, especially on the Arctic Slope, are very uniform in soils and vegetation.

We don't grid the system and log every hole, but we do examine a particular soil which is representative over a large area of uniform topography. Through our experience and past history in soil surveys, we are able to be very accurate in the determination of soils.

I grant that there are many inclusions of different kinds of soil, but when you can speak of being knowledgeable about 70 to 90 percent of the kinds of soils in a particular area, the inventory tells us quite a bit about the area.

We do log the soils information and make a detailed pit. But it is not like an engineer's survey. For on-site work of any kind you need a detailed engineering survey if you're going to spend a lot of money.

MR. Karl FRANCIS: I want to pursue Dr. Gal's question a bit further. I'm interested in the eastern and coastal plains there. Could you tell us how intensive the work was in that area? Did I understand you to say there are non-determined boundaries which have a line separating the soil conditions--soil types have been established and if you did, how did you establish them?

MR. FIBICH: There are soil boundaries between these associations of soils. I said we did not establish boundaries between the smaller units of the association, but we did attempt to state the percentage of each part of that association of soils.

MR. FRANCIS: And the boundaries, how are they established?

MR. FIBICH: The boundaries are established mostly by topography and landscape patterns. The soils have to be different between boundaries also.

MR. FRANCIS: You did not use satellite imagery?

MR. FIBICH: Not on the Arctic Slope, but on the Seward Peninsula we did. On the Arctic Slope of Alaska they just used conventional aerial photography, which delineates your vegetation also. In the future, however, I think we're going toward satellite inventories, especially in the inventory of vegetation.

MR. RHOADS: How far along are you in the survey project?

MR. FIBICH: We have just four and a half million acres surveyed adjacent to Kotzebue Sound on the NANA Corporation lease land.

MR. RHOADS: Is that completed?

MR. FIBICH: Yes. The field work should be completed in about a month and the report will be published about two months later.

Grasses for Revegetation in the Arctic

William W. Mitchell*

ABSTRACT
The topic is limited to grasses applicable for use on the Arctic Slope. The groundwork for revegetation research, stimulated and made possible by oil development activities, was provided by previous agricultural research and experiences in Alaska. Prior work on native plants at the Palmer Research Station gave impetus to the particular needs for research in the Arctic. Trials began there in 1969, and some plots still being monitored are now 6 years old. Materials of Alaskan origin or development in Alaska have been the most successful. Those tested from other northern regions have been found wanting. The research has led to the development of three new grass varieties from native plant sources. "Tundra" bluegrass was developed from arctic collections of *Poa glauca* and is the only known cultivar of true arctic origin made available for use. Tundra has been the best performer. "Alyeska" polargrass (*Arctagrostis latifolia*) and "Sourdough" bluejoint reedgrass (*Calamagrostis canadensis*) were based on collections made in numerous Alaskan locations. "Arctared" red fescue (*Festuca rubra*), a variety of uncertain origin developed at the Alaska Experiment Station, also performed well. "Nugget" Kentucky

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bluegrass, another Alaskan-developed variety of uncertain origin, was marginal. Other native grasses that performed well are under consideration for future development.

Introduction

Publicity stemming from the oil pipeline and related activities often has equated Alaska with the Arctic or the tundra. Thus the true Arctic loses much of its special significance. This symposium, by centering its attention on the Arctic, may dispel some of that confusion. My paper is concerned with grasses that may be used for revegetation in the Arctic, i.e., the region north of the Brooks Range divide.

The need for plant materials and knowledge of revegetation processes existed before the Prudhoe Bay oil discovery. This discovery ignited concerns about the possible effects of large-scale developments in the Arctic and created urgent demands for research. Concomitantly, many of the private companies involved in the development provided funding necessary for the conduct of the research.

The revegetation research has been based on the results of agricultural activities and investigations previously conducted in Alaska. But that experience did not extend north of the Brooks Range, so the Arctic was a vast unknown regarding the kinds of plant materials that could be used for revegetation. Preparation for the problem was abetted, however, by a program with native plant materials initiated at the Alaska Experiment Station in the 1950's with support from the Rockefeller Foundation. Native plants collected from numerous locations in Alaska have been under evaluation at the Palmer Station since that time. The program was furthered by collections made on an ecological survey along the pipeline route north of Fairbanks to the Arctic in 1969 (Mitchell 1970). The first use of a grass of known native origin resulting from the indigenous plant program at the Palmer Station occurred on Amchitka Island (Mitchell 1973, 1976a).

Arctic Trials

The first seeding trials were conducted in the Prudhoe Bay oil field in 1969. Most of those plots have disappeared for various reasons, but plots established since 1971 are still being evaluated. Extensive trials have been established on the original winter haul road system, on the

Arctic Gas test pipe facility, on an area scraped by a bulldozer during the thaw period in 1972, and more recently at the Kavik airstrip, a more inland station.

Some idea of the scope of the materials tested may be gained from the sources of these materials. Grasses included in the trials originated from Canada, Iceland, the Scandinavian countries, Russia, and northern states of the United States. These involved both named cultivars (varieties)* that are commercially available and experimental entries not in commercial production that have been collected in Alaska and other areas. Some of the cultivars have been in use in boreal regions of Alaska and others have been successful in trials conducted south of the Brooks Range.

There were two main objectives regarding the research on the application of plant materials. First, the short-term objective was to determine which of the available materials might be used to meet immediate needs. Second, the long-term objective was to determine what improvements could be made over what was available, looking in particular at native materials. Soil amendments necessary for establishment also were investigated. Durability of the stands and their reproductive capabilities are matters of continuing investigation.

The accomplishments with regard to the short-term objective can be summed briefly. Only two commercially available grasses were found adapted for use, and one of these was marginal in its performance. The cultivar, "Arctared" fescue (Festuca rubra)was the best performer of the named varieties. "Nugget" Kentucky bluegrass (Poa pratensis) was marginal, providing fair to good cover on some sites and poor or none on others. Many of the plants that can be used in other regions of Alaska failed in the Prudhoe Bay trials, attesting to the special character of the Arctic.

Both of the above cultivars were developed at the Alaska Agricultural Experiment Station at Palmer, but

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*Cultivars are plants that have been developed and released for commercial production and are generally known by a varietal name coined for that particular cultivar. The term "Cultivar" was derived from the two words, cultivated variety. The terms "cultivar" and "variety" are often used interchangeably.

circumstances under which the two grasses were obtained prevent positive determination of their true origins. Nugget bluegrass was developed from collections made at Hope, an old gold mining camp southeast of Anchorage (Anonymous 1965a). Most likely it was an introduction that persisted and thus became subject to the processes of natural selection under Alaskan conditions. It has provided a good, winterhardy grass for turf uses in Alaska (Klebesadel and Taylor 1972).

Material collected at the Experimental Farm near Palmer provided the base for Arctared fescue (Anonymous 1965b). Its occurrence there is a puzzle because the species does not occur natively in that immediate vicinity. It might have been used as test material in some of the earlier work at the Station, or it may have established there by some other means. It behaves very much like a native plant, but because of its history, it cannot be stated positively that it is indigenous to Alaska. Red fescue is a widely adapted species, and Arctared is commonly used in revegetation mixes (Taylor 1970).

For the long-term objective, a number of experimental grasses have shown potential for providing an improved seed mix for arctic use. All of these have been native grasses collected in Alaska. Work has progressed with some of them to the point of naming varieties and developing seed supplies for distribution to commercial growers. Following are the species of native grasses that have shown the most favorable results.

Common Name	Scientific Name
Glaucous (or Greenland) bluegrass	*Poa glauca*
Polargrass (Arcticgrass)	*Arctagrostis latifolia*
Bering hairgrass	*Deschampsia beringensis*
Bluejoint reedgrass	*Calamagrostis canadensis*
Alkaligrass	*Puccinellia* sp., possibly *borealis*
Red fescue	*Festuca rubra*

The best performer among these has been some material of glaucous bluegrass. Its performance has led to the

development of the cultivar "Tundra" bluegrass (Mitchell 1976b). Tundra is based on collections of native material made along the Sagavanirktok River in the Arctic in 1969 and 1970. Selections of individuals with the appropriate growth habit were necessary at Palmer for agronomic reasons. Ample seed has been produced of this cultivar for distribution to growers. It is believed that this is the first material of this species developed for use, as well as the first material of arctic origin released as a cultivar.

The cultivar "Alyeska" has been developed from material of polargrass collected from a number of locations in Alaska (Mitchell 1976c). Inclusion of a number of parental sources from different locations confers on the breeding material a broad genetic base. Only a small amount of Alyeska breeder seed has been produced. Further increase is under way for distribution to growers. This species also has received attention for its potential as a forage grass in Alaska, and it is under continuing study (Klebesadel 1969).

A cultivar of bluejoint reedgrass also has been developed and termed "Sourdough" (Mitchell 1976d). This variety is based on a number of collections from various locations in Alaska. As with the polargrass, the inclusion of a diversity of material in the breeding stock provides Sourdough with a broad genetic base. Seed is available for distribution to growers. The species is important to stock growers' operations in parts of Alaska and is under intensive study for its forage possibilities (Mitchell 1974).

Fig. 1. Bering hairgrass (Deschampsia beringensis) *and polargrass* (Arctagrostis latifolia) *are providing excellent cover on a relatively moist site. The cultivar "Alyeska" polargrass has been developed for revegetation use in the Arctic. Other native grasses also are being developed for use.*

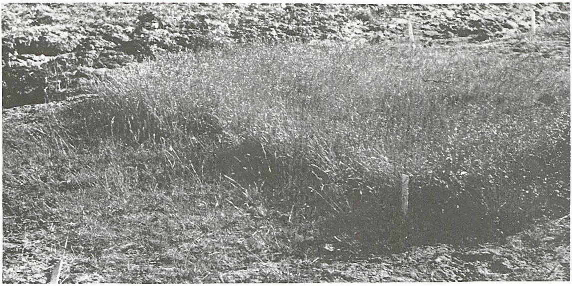

Fig. 2. "Tundra" bluegrass, a cultivar derived from arctic collections of Poa glauca, *has been the top performer on most sites in revegetation trials at Prudhoe Bay. It has provided excellent cover and persisted well for more than six years. Adjacent to the taller-growing bluegrass is a plot of red fescue* (Festuca rubra) *that has been grazed.*

Tundra bluegrass and Alyeska polargrass are expected to do better than Sourdough bluejoint in the Arctic Coastal Plain area. The bluejoint should do well in the foothill region.

Prices of seed of these grasses will probably vary according to seed yields obtained in the field. Because of difficulties producing and processing Sourdough bluejoint seed, it is likely to be the most expensive. Arrangements for seed production and purchase usually are made through the Alaska Crop Improvement Association headquarters in Palmer, Alaska.

Below is a suumary of varieties available or becoming available for use in the Arctic.

Arctared fescue--a fair to good performer
Nugget bluegrass--marginal in coastal plain region; probably better in foothill region.
(The above have been in commercial production for a number of years. The following are recently developed from native Alaskan material.)
Tundra bluegrass--the best performer, the only material available of arctic origin
Alyeska polargrass--a fair to good performer, better in lowland moist areas
Sourdough bluejoint reedgrass--somewhat marginal in coastal plain area but expected to be good for foothill region

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References Cited

Anonymous. 1965a. Notice of release of Nugget Kentucky bluegrass. Univ. of Alaska Agr. Exp. Sta. and U. S. Dep. Agr. Crops Research Div.

____. 1965b. Notice of release of Arctared red fescue. Univ. of Alaska Agr. Exp. Sta. and U. S. Dep. Agr. Crops Research Div.

Klebesadel, L. J. 1969. Agronomic characteristics of the little-known northern grass, _Arctagrostis latifolia_ var. _arundinacea_ (Trin.) Griseb., and a proposed common name, tall arcticgrass. Agron. J. 61:45-49.

____., and R. L. Taylor. 1972. New Alaskan grasses excel in winterhardiness. Agroborealis 4:9-10.

Mitchell. W. W. 1970. A scientific tour of the pipeline route. Agroborealis 2:4-5,22.

____. 1973. Using native plant resources for conservation. Agroborealis 5:24-25.

____. 1974. Native bluejoint: A valuable forage and germplasm resource. Agroborealis 6:21-22.

____. 1976a. Revegetation research on Amchitka Island, a maritime tundra location in Alaska. Univ. Alaska Agr. Exp. Sta. and U. S. Energy Res. Devel. Admin. Publ. NVO-172. 59 pp.

____. 1976b. Notice of release of Tundra bluegrass. Univ. of Alaska Agr. Exp. Sta.

____. 1976c. Notic of release of Alyeska arcticgrass. Univ. of Alaska Agr. Exp. Sta.

____. 1976d. Notice of release of Sourdough bluejoint reedgrass. Univ. of Alaska Agr. Exp. Sta.

Taylor, R. L. 1970. Red fescue--a valuable species. Agroborealis 2:8,10.

Considerations for the Use of Hardwood Stem Cuttings

in surface management programs

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ABSTRACT
Little new research has been started on use of woody plants in revegetation, although a major regeneration program has been begun in which several million woody plants will be collected and planted along the trans-Alaska oil pipeline. Exploratory work with hardwood cuttings has been done intermittently for about four years and has led to a cooperative study in Fairbanks, Alaska, by the U. S. Forest Service and the University of Alaska to examine rooting potential and field performance of stem cuttings of selected species. Research is ongoing but provides insight into variables that must be considered in work with hardwood cuttings. Variables included are species differences, within species and within plant differences, season of collection and planting, type of storage, planting medium, length and diameter of cutting, artificial treatment, and planting techniques. Both government-funded and private

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nurseries are needed to produce the broad range of plant materials needed. Good records of early woody plant revegetation research are necessary to the success of continuing research.

Since the surface protection seminar held about one year ago, there has been little additional research designed to assess the use of woody plants in revegetation. A major regeneration program has been started by Alyeska [Pipeline Service Company], however, which will result in the collection and planting of several million woody plants. In fact, it is proposed that about one million willow cuttings be planted north of the Brooks Range. Although several types of plant materials will be utilized, the vast majority of the plantings will involve the use of rooted and unrooted cuttings. Based upon practical and research experience with cuttings at northern latitudes, the program being undertaken is roughly analagous to a casual jogger being told to run a four-minute mile. In other words, we know that it is possible, but do not really know what it takes under our conditions.

I would like to zero in on the use of hardwood cuttings. (Hardwood cuttings are stem materials collected during the dormant season [winter] and used for propagation immediately or after a period of storage.) This work has been conducted intermittently over the last three to four years. As a result of this exploratory work, the U. S. Forest Service and the University of Alaska are conducting a cooperative study to examine the rooting potential and field performance of stem cuttings of selected species. Results of this study to date are summarized here but the bulk of this work is ongoing and results will be reported later.

It is necessary to distinguish between the two types of work that have provided the data for this report. Much of what is discussed concerns rooting potential; that is, what is the inherent ability of treated or untreated cuttings to produce roots under "optimum" conditions? Through these studies, we try to determine the relative ability of different species to root. Knowing this, it is possible to recommend the type of use for different species. The other type of work concerns field testing. These studies examined the ability of cuttings to produce established plants under environmental conditions commonly found in interior Alaska.

The majority of our research and observations has been

conducted with materials collected in the Fairbanks area. Within the past month, however, we had the opportunity to collect and examine the rooting potential of feltleaf willow (Salix alaxensis) from the Yukon River north to the Toolik and Ivishak Rivers. (This work was done in cooperation with Alyeska Pipeline Service Company.) Using the results from this work, we would like to examine briefly some of the variables affecting the performance of unrooted cuttings. I want to stress that these studies are not definitive. The quantity of materials used and the geographical area from which they were collected were limited. In general, however, our data appear to be similar to those of others.

Cuttings from nine sites north of the Yukon River were examined for rooting potential; five of these sites were north of the Brooks Range (Table 1). All cuttings are from the same species, feltleaf willow. Those from north of the Brooks Range, however, are S. alaxensis var. alaxensis and those south of the range S. alaxensis var. longestylis (Argus 1973). Cuttings were rooted in perlite and under intermittent mist (5 seconds of mist every 15 minutes). The results, although variable, show two trends. First, the material formed in 1976 performed poorest, regardless of area collected. Second, considering the pre-1974 and 1974-1976 material, there was a general increase in percent of cuttings rooted as age of material increased. The main exception to this was the Happy Valley #2 collection. In general, the percent rooting obtained from these cuttings was not as high as would have been expected from our previous experience with feltleaf willow cuttings from the Fairbanks area. (Alyeska Pipeline Service Company collected about one million cuttings from these areas in late winter and spring of 1977. Rooting success was in the range of 80 to 90 percent. The 1976 growth was not used, and the cuttings were rooted in small peat pots.)

Marked differences were observed in the ability of hardwood cuttings of five common interior Alaska willows to produce roots in aerated water (Table 2). S. alaxensis and S. novae-anglicae, two common flood-plain species, performed best. Cuttings collected in the spring rooted more rapidly than those collected in the fall. Two basic rooting patterns were observed (Chmelar 1974). The diffuse type had roots formed uniformly over the stem; in the basal type, root production is restricted to the base of the cutting. S. alaxensis and S. novae-anglicae exhibited the diffuse pattern (Densmore and Zasada, in press).

Table 1. Rooting of feltleaf willow cuttings collected from north of the Yukon River.

Year of formation	Yukon	Over-flow	Jim Creek	Cold-foot	Atigun	Ivashek R.	Gal-braith	Happy Valley #1	Happy Valley #2	Average by age or type cutting
					percent rooted					
1976	71(27)*/	20(28)	19(16)	17(13)	17(9)	48(30)	12(22)	36(25)	60(5)	34
1975	87(11)	50(13)	50(9)	22(8)	57(9)	70(10)	56(9)	59(6)	--	57
1974	--	63(4)	--	--	--	67(6)	69(8)	--	--	67
pre-1974	--	--	50(4)	23(13)	80(5)	--	84(3)	64(11)	50(6)	51
Heel cutting†/	--	--	69(11)	38(29)	25(10)	--	43(20)	--	43(7)	42

*/ Numbers in parentheses indicate the number of cuttings per replication. There were two replications for each area-age combination.

†/ Heel cuttings are those which included growth from two years.

Note: Three replications of six cuttings each rooted in aerated water performed as follows:

Source	Year of Formation			
	1974	1975	1976	
Yukon	--	100	lower 1/2 of growth 100	upper 1/2 of growth 50
Galbraith	100	100	56 (not separated)	

Table 2. Rooting ability of untreated stem cuttings of five taiga willows (from Densmore and Zasada, in press).

	Riparian Willows						Forest Willows								
Species	*S. alaxensis*			*S. nova-anglicae*			*S. scouleriana*			*S. bebbiana*			*S. glauca*		
Season	fall		spring	fall		spring	fall		spring	fall		spring	fall		spring
Days	30	60	30	30	60	30	30	60	30	30	60	30	30	60	60
% of cuttings rooting	75	98	94	40	44	88	2	4	10	0	0	0	0	1.0	2.5
Average number roots per rooting cutting	3.5	6.8	7.6	2.3	3.9	8.4	1.0	1.0	4.5	0	0	0	0	1.0	2.5

Further experiments using standard horticultural techniques (e.g. intermittent mist to maintain high humidity and rooting media of sand or perlite) have resulted in rooting of 60 to 80 percent of S. scouleriana hardwood cuttings. S. bebbiana rooted poorly even under these conditions (about 1 percent of hardwood cuttings produced roots). Under these conditions S. alaxensis had the diffuse type of root distribution and S. scouleriana the basal type. The relative success we have had with rooting hardwood stem cuttings of interior Alaska trees and shrubs may be summarized as follows:

Very easy to root
- Balsam poplar (Populus balsamifera)
- Feltleaf willow
- Tall blueberry willow (S. novae-anglicae)
- Sandbar willow (Salix interior)

Moderately easy to root
- Scouler willow (S. scouleriana)
- Bearberry (Arctostaphylos uva-ursi)

Difficult to root
- Blueberry (Vaccinium uliginosum)
- Labrador tea (Ledum groenlandicum)

No success in rooting to date
- Alder (Alnus crispa and Alnus tenuifolia)
- Highbush cranberry (Viburnium edule)
- Buffaloberry (Sheperdia canadensis)
- Aspen (Populus tremuloides)
- Birch (Betula papyrifera)
- Bebb willow (S. bebbiana)
- Greyleaf willow (S. glauca)

The species which we have found to be difficult to root or have had no success in rooting may root readily under other environmental conditions or by using softwood cuttings. For example, in Finland, good success has been reported with rooting of alder and birch.

The results of several field trials are summarized in Table 3. It must be stressed that these studies are not definitive as they represent plantings made in one growing season on one site. They are used as examples, and we hope they may provide a basis for more detailed research. In experiment 1, it was observed that the longer cuttings dried out and those which did survive produced shoots from buds located at or just below the soil surface. In experiment 2,

Table 3. Effect of selected variables on field performance of untreated hardwood stem cuttings of willow*/. Results based on survival after two growing seasons.

Experiment no.	Description of Experiment	Variables	Percent survival
1	Effect of length on survival of feltleaf willow cuttings; cutting length 10 and 36 inches; three replications with 100 cuttings in each or 300 cuttings per treatment; cut and planted in early May.	10-inch cuttings (2 inches above ground)	58
		36-inch cuttings (28 inches above ground)	16
2	Effect of species on survival; 2 species _S. alaxensis_, _S. scouleriana_; 4 replications with 50 cuttings in each or 200 per species; cut in February, frozen and planted in early May; 10-inch cuttings planted with 8 inches below the soil surface.	_S. alaxensis_	62
		S. scouleriana	17
3	Effect of planting medium on survival of feltleaf willow cuttings; two soil types, mineral soil (74% sand, 24% silt, 2% clay) and organic matter (6-8 inches of feather moss and other organic matter); three replications with 50 cuttings in each or 150 cuttings per species; cuttings 10 inches and planted as above; cut and planted early May.	Mineral soil	60
		Organic matter	4

(continued)

Table 3-continued.

Experiment no.	Description of Experiment	Variables	Percent survival
4	Effect of storage on feltleaf cutting survival; two treatments, cut and planted same day and cut in February, frozen (0-5°F) and planted early May; 10-inch cuttings planted as above; four replications with 50 cuttings in each or 200 per treatment.	Cut and planted on same day	58
		Cut, stored, and planted	62

*/ Cuttings from stem sections which were two growing seasons old; 36-inch cuttings in experiment 1 contained both two- and three-year-old wood.

S. alaxensis exhibited higher survival than S. scouleriana. These results are in line with those from much of our laboratory work, i.e., unless S. scouleriana is kept moist (e.g. under intermittent mist) rooting success is generally low. Experiment 3 suggests that we can expect little success with cuttings planted in organic layers on relatively warm, dry sites. These layers dry out rapidly and become unsuitable as a growth medium for most of the growing season. In experiment 4 there was no difference in survival rate between feltleaf willow cuttings which were cut and planted immediately and those which were cut during late winter and stored at 13° F for two months prior to planting. The cuttings were wrapped in wet paper and stored in sealed plastic bags before storage.

The research summarized here provides insight into some of the variables which must be considered when working with hardwood cuttings. Many of these insights could be gained by studying a horticulture text such as Hartmann and Kester (1975). Unfortunately, this type of background information is frequently overlooked in the rush of last-minute planning that seems to have characterized use of woody plants to date. These variables are species differences, within species and within plant differences, season of collection and planting, type of storage, planting medium, length and diameter of cutting, artificial treatment (e.g. use of hormones, intermittent mist, etc.) and planting techniques (e.g. depth of planting, surface treatment, mulching, etc.).

For most of the work with willow cuttings that is currently being considered in Alaska, it seems that the following variables are critical to success:

1. Species--Use only those species that are easy to root.

2. Storage--If cuttings have to be stored they should be stored under conditions that prevent drying, accumulation of excessive moisture, and breaking of dormancy.

3. Age of material--Use material that is two to four years old; older and younger material may not root as successfully.

4. Cutting length and diameter--Do not use longer cuttings than needed. From our experience, we suggest 10- to 12-inch material if unrooted materials are to be planted. Diameter is also critical but we have not examined this variable.

5. Site--Site conditions are most critical to success. Even the best plant materials will fail to grow on poor sites. Growing conditions on a given site may vary from year to year and within a given year. Because of this, planting methods that worked one year on a specific site may not be as successful on the same site the next year or at another time during the growing season. Many sites which must be revegetated provide marginal conditions because of poor soil conditions. Practices such as fertilization, saving and replacing topsoil after construction, or use of various types of mulches can be important in improving revegetation success.

Before closing, I would like to consider two points briefly. First, if we are to make our efforts in woody plant revegetation the most efficient in terms of materials, energy, and labor, we will not be able to depend solely on collection of plant materials produced under natural, unmanaged stand conditions. What is needed is a State or Federally funded nursery in conjunction with private facilities to produce the broad range of plant materials required in the future (e.g. rooted and rooted vegetative material and seed). A combination of public and private nurseries appears generally compatible in other States. Second, and finally, we need to maintain good records of these early woody plant revegetation projects. These records should include at least the five variables mentioned above. Without these records there is little chance of learning from our successes and failures.

Literature Cited

Argus, George W. 1973. The genus *Salix* in Alaska and the Yukon. National Museums of Canada. Publications in Botany No. 2. Ottawa, Canada. 279 pp.

Densmore, R. A., and J. C. Zasada. Rooting potential of untreated willow cuttings in Alaska. In press. (Submitted to Canadian Journal of Forest Research.)

Chmelar, J. 1974. Propagation of willows by cuttings. New Zealand Journal of Forestry Science 4:185-190.

Hartmann, H. T., and D. E. Kester. 1975. Plant propagation; principles and practices. Prentice-Hall, Englewood Cliffs, N.J. 662 pp.

Session 6 Discussion

MR. BOONE: Have you or your staff made any studies on the possibility of building a pipeline across a glacier? What would the ramifications be?

MR. FERRIANS: We have never entertained the possibility of constructing a pipeline across a glacier. If this were done it would have to be a temporary type structure because an active glacier is moving at all times. There is one example in Alaska that I can think of, however, where an engineering structure, a major structure, was put across an active glacier. This was the Copper River Northwestern Railroad. A small part of it was actually constructed across a glacier, but it had to be rebuilt essentially annually and constantly maintained. I don't think it would be practical to try to construct a pipeline across an active glacier.

I've learned over the years that almost anything is possible from an engineering point of view if you have enough money and time. But to be practical about this, I don't think it would be appropriate to try it.

A glacier moves many feet a year, and you'd have to build the structure aboveground, make it very temporary, and maintain it constantly. It's hard to imagine a situation where it would be practical to do this, not that it would be impossible if you wanted to spend that much money and time on it.

MR. LONNIE BROOKS: When you showed that five-foot ditch, you mentioned that was a typical seismic line.

MR. FERRIANS: That was probably a misstatement on my part. I'm talking about a typical one of that era, about 15 years ago. When those seismic trails were made in that part of Alaska, there was no control over what they did and most people didn't care. They weren't even interested in what was going on up there. It was a common practice on those old trails to drop the blade and remove the vegetation matter. They did this in many areas. I guess I should have added that it was common for that period of seismic trails. Obviously, they don't do that now.

MR. FIBICH: When you make these tests, do you make cross-studies on different kinds of soil like well-grained, coated-grain or do you take these things into consideration?

MR. MITCHELL: We try to pick a variety of sites as well as we can. One of our problems is finding disturbed sites on which to do this work. Of course, in the Prudhoe Bay region there was the haul road. Much of that is well-drained, but it actually is a relatively dry site. We probably got over a mile and half to two miles a plot on the haul road, and if we stay at it enough years we'll have it planted. There now is an area where the surface was scraped off and we didn't plant there.

These grasses are not the final answer but I certainly feel better about the situation than I did six years ago. We hope to find better answers in the future. I have looked at thousands and thousands of plants in the nurseries over there and I expect I will be looking at thousands more. However, there are still some problems.

Snow Gathering Techniques on the Arctic Slope

Dora L. Gropp*

ABSTRACT
Experimental snow fences were built at Prudhoe Bay, and in October, November, and December 1976, observations were made as to their effectiveness in collecting snow for construction. One fence was placed parallel with the prevailing wind and one perpendicular to the wind. The fences were constructed of 2x4 posts (construction grade lumber) 5 feet high, with 50 percent porous nylon fabric 4 feet high stretched between them. Both fences collected enough snow for road construction by November 30. As predicted, less snow accumulated against the parallel fence than against the perpendicular fence. Although it was porous, the fence fabric sometimes became 100 percent closed, or had 100 percent density. At that density, the fences collected less snow than those with 50 percent porous fabric. Drift density measurements also were made.

As you heard this morning, snow roads and snow pads probably will be the construction of the future in the Arc-

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tic. There was enough snow for construction last winter, but usually, as we all know, the Arctic Slope area is unlike other parts of Alaska and receives little precipitation.

If snow is needed for construction, it must be gathered and the answer to that is snow fences. Snow fences have been employed for snow gathering or prevention of snow drifts in Wyoming and other continental States. R. D. Tabler, at the Rocky Mountain Forest and Range Experiment Station Forest Service, U. S. Department of Agriculture, has worked out the theoretical background for snow fences. Using this information, Arctic Gas built a number of snow fences in Prudhoe Bay last year.

The unusual thing about our experimental snow fences is that they must be more or less parallel with the prevailing wind directions. Wind directions on the Arctic Slope are mostly northeasterly or southwesterly, changing from one to the other rather rapidly.

In the winter months, 50 percent of all winds exceed 10 miles per hour. This is assumed to be the speed we need to move snow that is already on the ground. Of these winds, 60 percent come from the east and 40 percent from the west.

How well do these winds perform on a snow fence located parallel or within plus or minus 20 degrees of the prevailing wind direction? We know that the gathering of snow against snow fences is influenced by the height of the snow fence, by the density of the fencing material used, and by the bottom gap. The bottom gap is the space between the foundation or the terrain height and the bottom of the fence. This gap more or less influences the distance at which the drift starts in relation to the fence. It also, therefore, influences how long the fence will be capable of collecting snow until it is drifted over. Once a fence is drifted over, it stops collecting snow.

We tried to get the snow fence parallel with wind direction. The wind shift is between 50 and 90 degrees over an average winter. Usually, the wind turns around and goes the other direction, 215 to 255 degrees westerly direction. Fig. 1 is the site plan, showing locations of the snow fence and prevailing wind direction.

In order to achieve early accumulation, we need a sufficient amount of snow. Using the requirements I've been given by the construction people, we would need 170 cubic feet of snow per lineal foot of fence in one direction. I

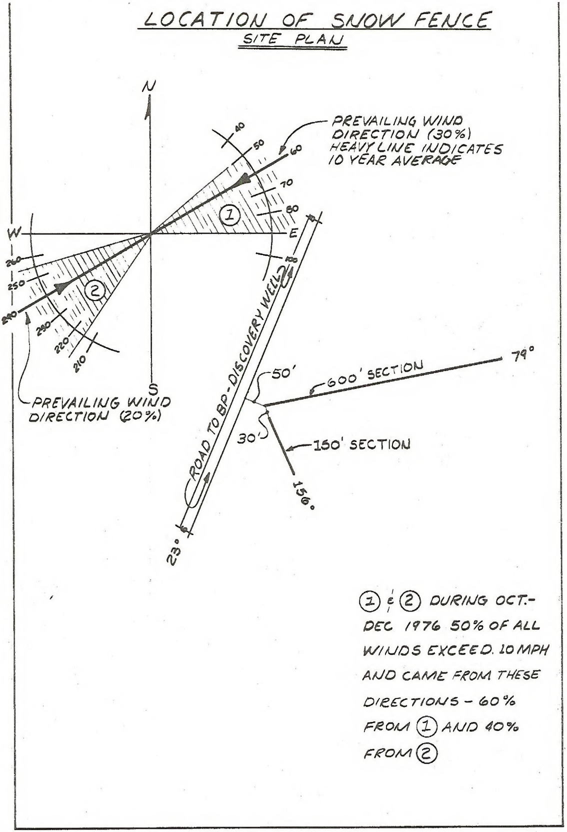


Fig. 1. Site plan showing location of snow fence.

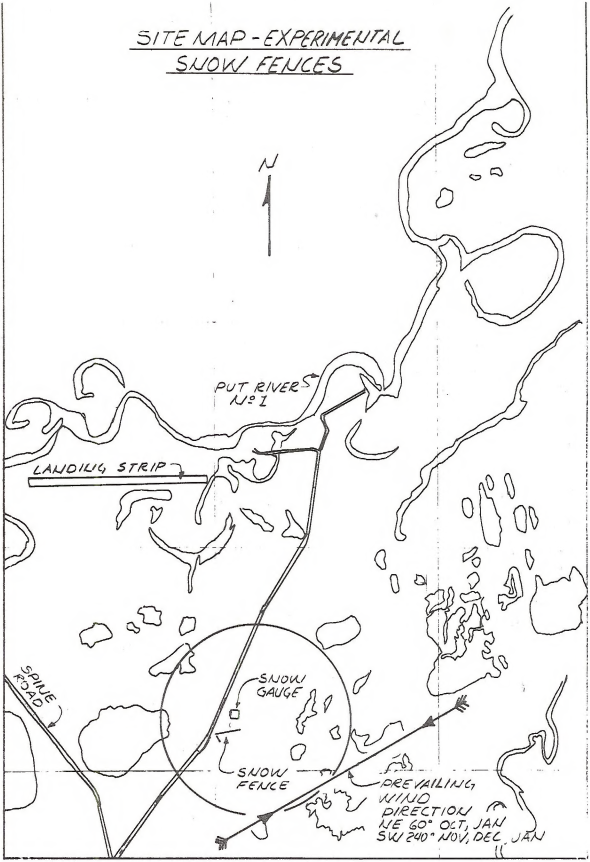


Fig. 2. Site map showing location of experimental snow fences.

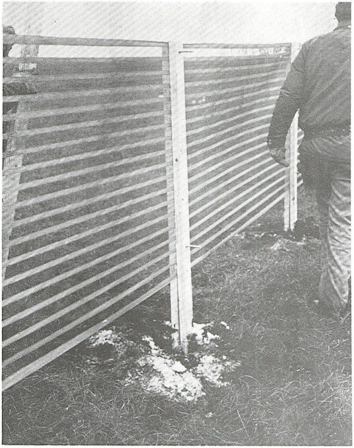
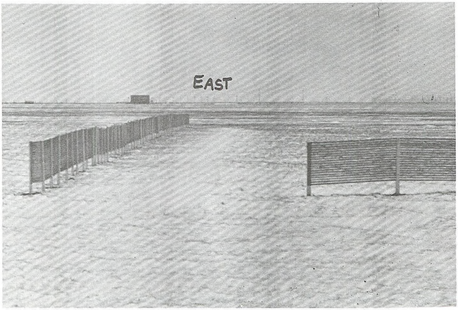


Fig. 3. (Left) Detail of fence post construction.

Fig. 4. (Below) After three days of equally distributed east/west winds, the drift caused by the east wind is much more visible than that caused by the west wind.



was trying to find out whether or not a fence oriented parallel with the prevailing wind would achieve this, and at what time.

We put up a perpendicular fence section 150 feet long, just for comparison. Unfortunately, the distance between the fences was not enough to prevent interference between the drifts but the fences are long enough to show how the snow is gathered.

Fig. 2 shows the general location of the fence in the Prudhoe Bay area.

Within a week we had to make decisions on whether or not to build a fence and what materials to use. We used 2x4 construction lumber as fence posts and stretched fabric between them. A section of the fence is shown in Fig. 3. The fabric is nylon with 50 percent porosity. It had been tested and found to fill the requirements best. The 2x4's are bolted together. The holes were drilled with a six-inch drill mounted on a Rolligon so we had no problems. Everybody worked on it, and it worked out well.

Very early in October, we had the first snowfall. It lasted only two days. The wind was from the east at a rate of 20 or 21 miles per hour. Some snow was deposited along the fence. On October 12, we had three days each of west and east wind equally distributed, and the drift caused by the east wind was much more visible than that caused by the west wind (Fig. 4).

In early November we had five days of east wind and three days of west wind at rates of between 30 and 90 miles per hour. The wind from the east was stronger than the wind from the west. Usually the west wind deposits more snow. By November 8 we had almost half of the amount of snow that the snow fence would accumulate (Fig. 5).

Fig. 6 shows the perpendicular fence on November 23. You can really see the displacement of the snow; there's a definite gap between the fence and the drift. The gaps on either side of the fence are still visible and you can see the vegetation coming through.

Fig. 7 shows windward drift on a parallel fence. By December 4, when there's no sunrise in Prudhoe Bay, the snow had filled in the gaps, and they were more or less gone. From that point on, although we took more readings, the amount of snow gathered did not increase much. But the

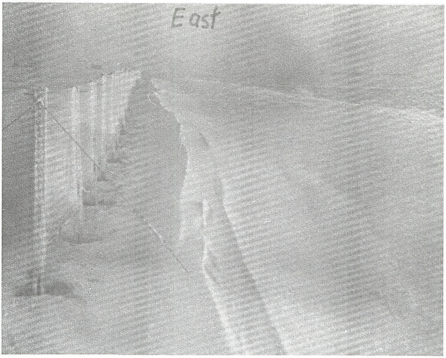


Fig. 5. By November 8, the fence had collected almost half the total snow it accumulated.

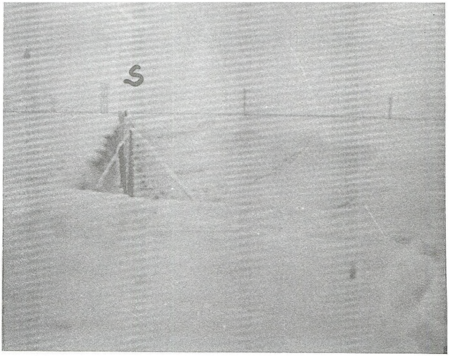


Fig. 6. The perpendicular fence on November 23.

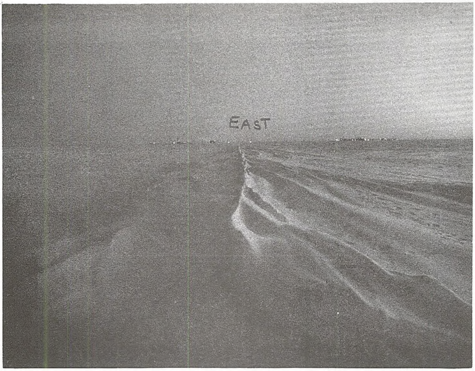


Fig. 7. Windward drift on a parallel fence.

drifts were being relocated, replaced, and accumulated again.

The drift profiles we took at different times are shown in Fig. 8. On the perpendicular fence, we took readings on November 3 and 23 and on December 28. On the 23rd the gap was beginning to fill. At the end of November, we had a storm, and the fences were blown over. So the final accumulation was essentially there by the end of November. Total usable drift width of the parallel fence was 98 feet. This included both sides. Accumulation was on both lee and windward sides of the fence, and a total height of the drift was 3-1/2 feet.

The photograph taken December 28 shows that the drifts are almost even on both sides (Fig. 9); again wind direction shifts 180 degrees on the Slope. The parallel fence definitely collected less snow than the perpendicular one but this was predicted. It goes right with the cosine of the angle at which a snow fence is oriented compared to the prevailing wind direction. You will accumulate that much less the closer the fence orientation is to the prevailing wind direction. That is exactly what happened.

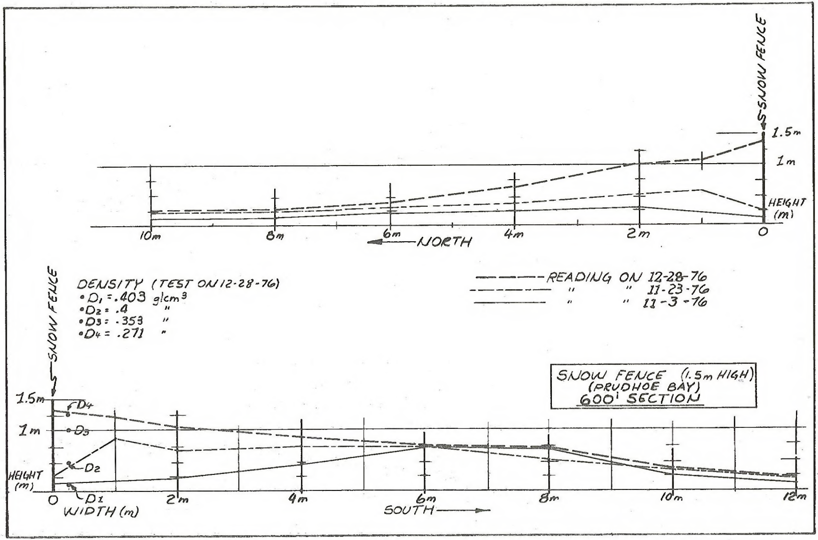


Fig. 8. Snow drift profile, 600-foot section. Winter 1976-77.

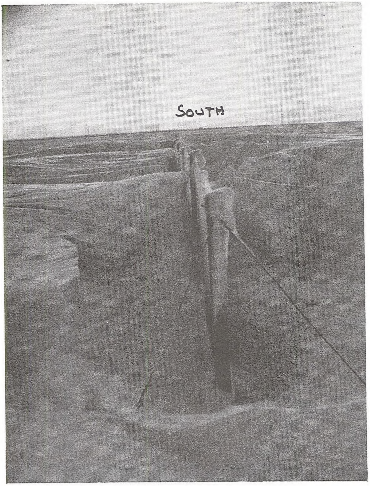


Fig. 9. In this photograph taken December 28, drifts are almost even on both sides of the perpendicular section of the experimental snow fence.

Now we are planning a final design for the fence. The fence must be easy to move. The panel width should probably be whatever the optimum is to allow for minimum bulging of the fabric. The design I made was dictated by the available 2x4's, but I think we could go to 50 feet if we used a nylon pilot wire to keep the fabric from sagging. Some sagging is going to occur as the snow collects but once we remove the snow, the fabric will be released and spring right back.

Another problem I encountered is that the snow fences were a little dense even with 50 percent porosity. Being cloth, the fabric has to have interwoven spaces, and they

sometimes became so packed with snow that the fences were 100 percent closed. In other words, they had 100 percent density. According to the research that has been done, fences that are 100 percent dense will not accumulate as much snow as fences with 50 percent porosity. We are looking at other materials, but because fabric is lightweight and easily manageable, it's the way to go.

At one point we worked on drift density measurements. On the parallel fence, density on top measured about .27 $glcm^3$; the next spot, about a third in, was .25 $glcm^3$. On the bottom the density was .403 $glcm^3$, which according to construction experts, you can drive on with a heavy load.

FROM AUDIENCE: What was the height of the fence?

MS. GROPP: That was dictated by the fabric width, which is 46 and 48 inches.

MR. SLOAN: Did you get the 170 cubic feet per linear foot from a fence?

MS. GROPP: Yes I did. With the parallel fence I got 506 cubic feet, but that is, of course, not the point. With the desired density of .5 $glcm^3$ this scales down to about 350 cubic feet, but it is still more than required. And this occurred at the end of November when the majority of the snow didn't fall until, I think, it was December or January. Here we had snowfall between September, October, and November of 1.5 inches. This is liquid measure and would be equivalent to about eight inches of snow.

MR. GUINN: I have two questions--one: Do you know any reason why the 100 percent density snow fence accumulated less snow than the 50 percent density?

MS. GROPP: I would prefer not to go into that right now because I really don't know enough about it. It has something to do with the venturi effects and the openings and whatever else, I really don't know. Tabler and the Forest Service people have done a lot of work on it and I am pretty sure that if you are really interested I can get some information for you on it. Most of the densities were arrived at by experiments and actual field tests.

MR. GUINN: The second part of my question is: Do you have any reason to believe that this research will have similar results in NPR-A and the Arctic Wildlife Range?

MS. GROPP: Yes, I would say so, because the weather data that I have show that the wind directions are pretty uniform on the Slope. If you have a storm, you have it all over. The speeds are different and I think the amount of snow that travels with that wind will be different, too. We have arguments about that. New dry snow will start blowing or moving at much lower wind speeds than hard drifts or old snow. There may be a difference on the west half of the Slope as far as the amount of actually falling snow is concerned.

Canadian Arctic Gas put up fences in Komakuk which is right across the border, and at shingle point they performed about the same. They had one with conventional slat panels and one with fabric and the difference was not much. If anybody has doubts about which material to use, the fabric seems to work out all right.

Surveying with Refined Inertial Guidance Equipment

George P. Oviatt*

This is a slide presentation on inertial modification, how we refine it to use it for surveying. I'll show this and then explain what we in the BLM have done with the Auto-Surveyor here in Alaska the last two field seasons.

(The following transcript is of the recording of the voice accompanying slides.)

In almost all modes of surveying, we must in some way rely on line of sight between two objects. Although efficiently dealt with in the modern technology of electronic distance-measuring systems or the latest in satellite geodesy, line of sight requirements are a handicap.

The development of inertial guidance systems and their applications in surveying have eliminated this handicap. The Auto-Surveyor promises to be only the first of many systems of its kind available for surveying. It is totally self-contained and able to continually sense changes in its own location, and it is able to display this information continuously.

Tests have found this system efficient on the ground as well as in the air. The Auto-Surveyor system is principled on Newton's laws of inertia. A body continues in a state of rest or uniform motion in a straight line unless it is acted upon by an extreme force. The acceleration of a body is directly proportional to the force acting on the body and inversely proportional to the mass of the body.

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To every action there is an equal and opposite reaction. We have somewhat modified our understanding of these laws since their first publication in 1687. We now know that a body that appears to be at rest is in fact traveling at the same fixed velocity as we are on the earth's surface. As shown here, "at rest" is demonstrated only in terms relative to the immediate surroundings. Acceleration is the rate of increase in the speed of a moving object. Whether slowing down or speeding up, the ball and string pendulum provides a simple accelerometer that makes a distinction between our notion of "at rest" or any other fixed velocity.

However, when the helicopter accelerates, the pendulum reacts to this force. Accelerometers capable of measuring minute changes in velocity are the first step in the development of an inertial guidance system.

Let's look at some simple illustrations that will help explain these accelerometers. A slug or weight known as a test mass is set in a frictionless case so that it may move back and forth freely. The slug is held in this frame at the null or zero position by two springs. Any outside force such as an acceleration applied along the axis of the frame will cause the slug to exert a like force in the opposite direction against the springs. This force will be directly proportional to the rate of acceleration.

By electronically measuring the amount of spring force required to maintain the slug at the null position, acceleration can be effectively measured. To measure acceleration in more than one direction, a combination of accelerometers may be used mounted horizontally and vertically on a platform.

In all forms of navigation, in order to guide an object from place to place, a reference system is needed to describe direction. If we lived in a flat world, simple coordinates of X and Y would easily be sufficient. However, in our three-dimensional world we require a reference system that not only provides for the Z coordinate, but that will also operate in reference to the earth's rotation and its spherical shape.

Gyroscopes or gyros conform to the laws of inertia. They exhibit a peculiar characteristic known as gyroscopic inertia. This characteristic can be described as angular stability, whereby the axis about which a spinning mass turns, such as a wheel, tends to maintain a fixed direction unless it is acted upon by an outside force.

The angular stability of a gyro is directly proportional to three factors and may be increased in three ways:

- *By increasing the rate of spin;*
- *By increasing the mass of the wheel;*
- *Or by increasing the radius of the wheel.*

For the purpose of inertial guidance, the next step is to impart the angular stability of the gyroscope to the accelerometers mounted on the platform This may be done by mounting the gyros in such a manner that the platform will be stabilized as the spinning gyros stabilize.

We now mount this platform in a case so that it has angular independence and is free to react when acted upon by acceleration. Through electronic measurement of the angular variance between the case and the gyro-stabilized platform, we are always able to determine the angle of the outside force acting on the platform.

The illustration is simplified. Let's see how it will work under practical conditions. In the field the surveyor begins the day by activating the system in the helicopter while it is still on the ground. An undisturbed hour is needed for alignment and calibration. This initial alignment period occurs at a known location with the helicopter hoversite positioned directly over the monument. On this map this location is known as Point "A." Point "B" is another known location, which will be used later in the day for elevation and position update.

Points one through eight are locations to be monumented. Latitude and longitude for each of these locations are fed into the Auto-Surveyor computer, with an elevation and position update of its present position. Thus, the computer knows where it is and where it wants to go. At lift-off, acceleration as it is measured along each axis is integrated with time, and this, in turn, is calculated to determine the distance traveled.

The track and range readout in the cockpit continuously displays both the distance and the direction to the next point. The pilot merely guides the craft by observing the continuous readout. To reduce error in the system, the pilot must bring the ship to a complete stop, either by hovering or landing at regular three-minute intervals along each run for a stabilization period known as a zero velocity update--(or ZUPT). For maximum efficiency, a landing is more desirable than hovering. When a predicted drop location is reached, as indicated on the display, the pilot hovers and drops the pipe. He then must locate the pipe on the ground through the hoversite, and the computer records its exact location. The crew is then ready to proceed to the next drop location and repeat the procedure. When all the pipes on a run have been dropped, the pilot flies to Point "B," where he lands once again with the hoversite directly over the monument. The computer is given its exact location. This is recorded and compared with its own computation which has accumulated slight errors while in flight.

This factor of error is now used to adjust the raw data describing the drop points into what is called smooth data, with the update completed. The crew then retraces the run, once again locating the drop points and actual locations of the pipe on the ground. This information is stored in the computer. After the reverse run and

landing at Point "A" are completed, another update is fed to the computer and the second run is adjusted to smooth data. The combined information for the two runs is averaged back at camp, where extremely accurate directions for setting the monuments are written for the ground crews that follow to set the monuments.

The application of inertial guidance systems in surveying has opened a whole new era for the surveyor--an era only recently born here in Alaska. We are still learning how to adapt our own field operations to the new problems we encounter. Speed and mobility are just a couple of the uncommon advantages we now enjoy, and they have made it necessary to re-assess our support efforts in logistics and communications. As we continue to explore and innovate, more than ever before, the individual surveyor must be flexible and versatile in his thinking and his ability to adapt to the changing aspects of his job. More than ever before, the task requires the complete surveyor, fully prepared to meet the challenges of placing that monument in the ground.

[End of Recording]

Mr. Oviatt:

Inertial navigation was first improvised when the military had need for navigation without the use of radar or some similar means. Litton Guidance and Control developed inertial navigation systems to accommodate the military.

In the early 1970's, BLM became interested in the system for use in cadastral surveying. From 1974 to 1976 extensive testing was performed by BLM and our first system put into production. We now have two systems into full production. The Auto-Surveyor is used not only in Alaska in the summer, but in the Lower 48 on winter projects for the BLM.

With the two systems, we have surveyed to date approximately 7.8 million acres of land in Alaska. Our cost here in Alaska is approximately $700 per corner established.

We in the Auto-Surveyor world hope that in the late 1980's, we will have a system that will be less costly and light enough for a man to carry around.

Many reports have been written about the use of the Auto-Surveyor, and I can furnish them to anyone who is interested.

Ice Aggregate Road Construction

Edwin N. Fisher, P. E. *

ABSTRACT
The construction of roads and other such structures of gradated ice aggregate manufactured by crushing ice has been investigated by both laboratory and scale field testing. This report contains the results of a field test conducted in Fairbanks, Alaska, during the period of February 22 - March 8, 1977. The results indicate that performance of roads constructed of ice aggregate compares favorably with that of roads constructed of snow. Field experience has shown that ice aggregate roads can be constructed faster with lower equipment and manpower requirements than saturated snow structures. The concept of in situ crushing of ice on the surface of frozen streams and lakes has been explored and found promising. Damage to fragile ecosystems may be greatly reduced by using single pass, thick-section ice aggregate construction techniques.

Today I would like to tell you about a new wintertime construction technique that can be used for the building of

*Mr. Fisher is an Independent Consulting Engineer. He developed the ice aggregate construction concept for Alaskan Arctic Gas Service Company.

temporary access roads, work pads, and runways in arctic and subarctic regions.

Before starting, however, a few definitions are in order. We use terms freely, and I think the different methods of temporary winter construction need to be better defined. I may define a snow road differently than some of you. To me, a snow road is one made only of snow. The construction technique involves the working and compacting of dry snow until it has developed through a process of sintering into a firm, dense work surface. The technique has been well developed by the U. S. Navy and is described in detail in their Design Manual - Cold Regions Engineering - NAVFAC DM-9. The technique has not been used to any extent in Alaska.

The second type of so-called temporary snow road we see, and the one that is most frequently used in Alaska, is what I call a saturated snow road. In this technique a layer of snow is flooded with water and acts as a sponge to hold the water until it is frozen. A new layer of snow is then spread over the frozen layer and the process repeated. The resulting structure consists of multiple layers of nearly saturated snow-ice. The process requires a large quantity of water and like the Navy's snow road, takes a great deal of time and equipment.

A third type of temporary wintertime construction we see is usually called an ice road. A dike of some sort is erected and the road or other structure is constructed by systematically flooding the enclosure with water and permitting it to freeze. The structure is thereby constructed of numerous lifts of solid ice. Although one of the best-known applications of this technique was the construction of the Yukon River ice bridge, its use is not restricted to rivers or lakes.

The technique I want to tell you about is new. We call it "ice aggregate" construction. "Ice aggregate" is defined as a reasonably uniform gradation of ice particles, ranging in size from several inches in diameter to "fines." "Fines" are those particles that pass a two and a half millimeter sieve.

As most research projects go, we haven't been working on this very long. The concept was first suggested to Alaskan Arctic Gas Study Company in November 1976. By late December the construction of a special test facility was completed. The facility is of such size as to permit the

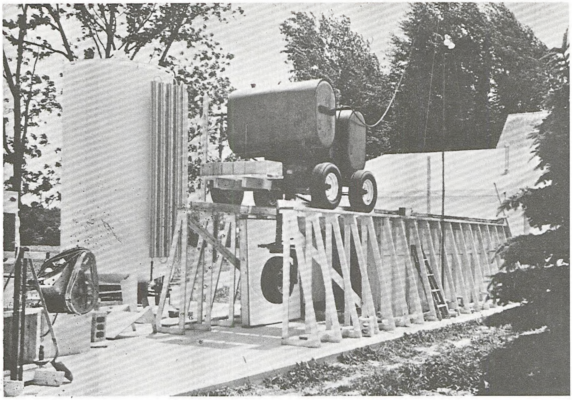


Fig. 1. Ice aggregate test facility.

testing of full thickness ice aggregate structures under rolling and static wheel loads. Road prisms with toe of slope widths of 5 feet and up to 24 feet long can be accommodated and subjected to ambient temperatures as low as -50°F. The facility is shown in Fig. 1.

The laboratory tests were started in January 1977. Within a month to six weeks, the results were encouraging enough for a full-scale field test to be planned and subsequently mobilized on February 22. From February 22 to March 8, six test sections were constructed and evaluated. During the period following March 8 through breakup, the sections were periodically observed. Fig. 2 is an aerial view of the Fairbanks test site taken after March 8. We are presently continuing lab tests based on questions raised during the field test and are planning further field tests for this winter.

Initial laboratory testing involved investigating the importance of gradation, the influence of fines, and the

Fig. 2. Aerial view of test site at end of test period. Fairbanks, Alaska, winter 1977.

time rate of natural bond formation on load-bearing strength.

One of the most significant findings of the initial laboratory work was that ice aggregate simply dumped and graded could, after the necessary bonding period, carry significant compressive loads without compaction.

After bonding periods of 24 hours during which the ice aggregate was not disturbed, it was found to be able to carry static loads to the limit of the laboratory's testing capability, i.e., 250 psi.

Mobilization for the field test took a major effort but through tremendous cooperation of everyone involved, the first test section was begun on February 22.

Ice was harvested from the surface of a slough by ripping it with a D-8 Caterpillar. Ice chunks as large as a couple feet in diameter were ripped and trucked to a stockpile at the test site. As needed the ripped ice was dumped

Fig. 3. Ice crusher set up for production of aggregate.

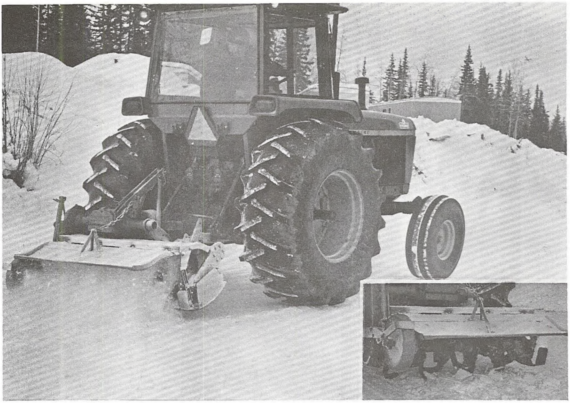


Fig. 4. In situ ice crushing.

into a slightly modified commercial ice crusher using a conventional front end loader. Fig. 3 shows the entire crushing process in operation.

Crushing ice is an interesting process; it's a low-speed, low-energy process. This particular crusher was driven with a five horsepower motor and could crush ice as fast as it could be fed with a two-and-a-half cubic yard capacity front-end loader.

The crushed material ranged in size from approximately baseball size to snow. The crusher design permitted limiting the maximum size by the adjustment of an internal gate. With only one exception we worked with the crusher gate wide open.

Fig. 4 shows a second method of manufacturing ice aggregate which was tested during the field test. We call it "in situ" crushing. The device is a standard Howard "Rotavator" modified only by sharpening the tines which are shown in the insert. Using this machine, ice was crushed at the source. The major difference between this method

Fig. 5. Placing ice aggregate test section.

Fig. 6. Grading ice aggregate test section.

and the other is that the in situ crushed ice particles are flaky and those from the commercial crusher are more spherical in shape. We have a few reservations about using this aggregate shape and plan further evaluation.

As the ice was crushed, a front-end loader took it from the front of the crusher, as shown in Fig. 3, to the test section under construction. There the crushed ice was dumped in a continuous single lift of approximately three-foot thickness. Grading was accomplished by back-blading with the bucket. These two operations are shown in Figs. 5 and 6. This was the total placement operation, a three-foot-thick section of ice aggregate was placed and graded with only the bucket on a front-end loader.

As mentioned earlier, laboratory results showed that when ice aggregate is left undisturbed for periods approaching 24 hours, the natural bonding that occurs will support substantial compressive loads. This was demonstrated in the field by traversing the first test section constructed less than 24 hours after it was constructed with the front-end loader shown in Fig. 6. The only failure mode that was observed was that of disaggregation of the surface ice particles due to the tractive force exerted by the driving wheels. It was apparent that although the ice aggregate

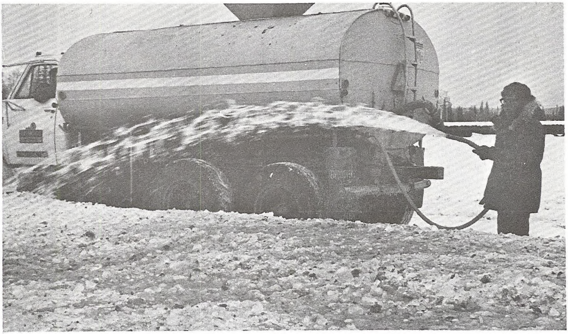


Fig. 7. Developing bond layer with water on aggregate.

structure exhibited satisfactory compressive strength, disaggregation of the surface layer resulting from traffic would soon render the surface useless.

In an attempt to develop a better wear surface, less subject to disaggregation under tractive forces, water was added to the top surface to form what we call the wear layer.

The ground pressure of the only available water truck would not permit its use directly on the surface of a just-placed ice aggregate test section, so it was driven beside the test section and water was sprayed on the surface. This process is shown in Fig. 7. It was not possible to accurately measure the amount of water applied. It was applied until the surface appeared saturated.

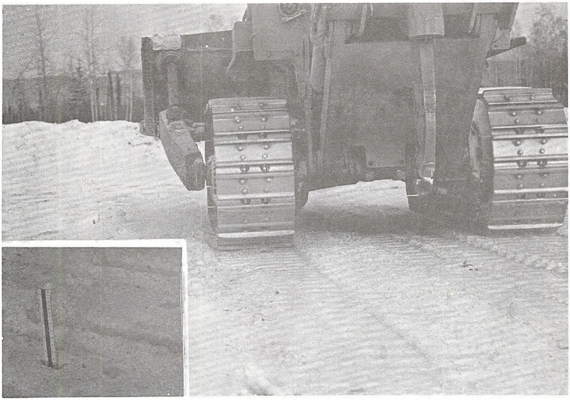
In an early test prior to forming the wear layer, an experiment was performed to determine the compressive strength of just-placed ice aggregate. A John Deere 350, wide-track bulldozer, with a track pressure of about 2.7 psi, was used. It was found that the bulldozer could be used on the surface immediately following placement. The importance of this will be discussed later.

One of the test sections was constructed in the form of a "J." It is shown in Fig. 2 as Section No. 3. The section was more than 400 feet long and varied in width from about 18 feet to 24 feet. It was designed to permit the evaluation of curves and ramps under heavy wheeled traffic.

Seventeen hours after the construction of the first portion of this section and application of bond water, a conventional dump truck weighing 66,640 pounds with its tires inflated to 85 psi was driven onto it with no apparent failure resulting. This event is shown in Fig. 8. Subsequently, over a three-day period, a loaded dump truck made 1,000 traverses of the entire "J" section. At the end of this test there was no observable differential compaction in the tire tracks. There was no evidence of slope failure, and cracks which formed across the section due to temperature-induced contraction had no influence on performance. During the test period, temperatures ranged from a low of -30°F to nearly 32°F. During the test period, no maintenance of any type was done on the test section.

After the successful rolling load test, we were interested in learning how the road surface would behave under track loading conditions. For this test a blade-equipped

Fig. 8.(Above) Wheeled vehicle loading of ice aggregate test section. Fig. 9. (Below) Tracked vehicle testing of ice aggregate test section. Inset shows condition of wear surface.



D-8 Caterpillar, with a total weight of approximately 80,000 pounds, was used to make 150 traverses of the section. The result was that the wear surface was milled to a depth of approximately two inches. Fig. 9 shows the test section at the end of the test and the insert shows the condition of the wear surface.

The final test programmed was expected to totally destroy the bonding within the tested section. A VIBRO-PLUS compactor, shown in Fig. 10, weighing 46,000 pounds, vibrating at 1,700 vibrations per minute and applying a ground force of 550 pounds per lineal inch of roller, was used to traverse a test section. After 40 traverses, the test was stopped because of failure of one of the ramps. Gradual failure of the wear surface occurred in the path of the compactor and was of a spalling nature. It was found, however, that newly fallen snow on the slopes was undisturbed. A worker could barely feel vibrations from the compactor even when he was standing on the section next to the compactor. No other failure was evident. Catastrophic bond

Fig. 10. VIBRO-PLUS compactor testing ice aggregate section.

failure did not occur. The test section was not reduced to the loose consistency normally associated with crushed ice.

It is important to reiterate that each of the test sections used in the foregoing three tests, i.e., rolling load, track load, and vibratory load, was constructed as a single layer, three feet thick, with only enough water applied to the surface to form a porous wear layer.

Following these tests a SIPRE ice core drill was used to take cores from each of the sections. Fig. 11 is a section from one of the cores. It clearly shows the large particles of ice aggregate within a matrix of the finer particles.

The as-placed density of the ice aggregate used in Test Section No. 3, "J" section, was 42.6 lb/ft^3 (0.68 gm/cm^3). A void space of approximately 25 percent exists.

After the test section was traversed 1,000 times, a core taken from the wheel track yielded a density of 44.1 lb/ft^3 (0.71 gm/cm^3). Less than three and one half percent decrease in void space occurred after bond layer water was added and the section was compacted from the wheel load from the as-placed condition.

In Fig. 2, the aerial view of the test site, Test Section No. 1 was used for the vibratory compactor test, Test Section No. 2 was subjected to the tracked Caterpillar bulldozer test, Test Section No. 3, "J" Section, was traversed by the loaded dump truck. All three sections ~~e constructed essentially alike, using ice aggregate

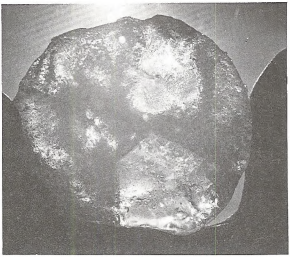


Fig. 11. (Left) Core from ice aggregate test section showing large ice particles within a matrix of finer particles.

manufactured with the conventional ice crusher, placed in a single lift, and sprayed with water to form a bond layer.

Sections No. 4, No. 5, and No. 5a were constructed from ice harvested in situ using the rototiller. They were constructed in multiple lifts, each saturated or nearly saturated with water. The resulting structures were of much higher density than the first three test sections.

Section No. 6 was constructed as a conventional saturated snow road. Snow scraped from the test site and stockpiled was distributed, saturated with water, and dragged to develop a structure by what has been the standard method. The most notable difference between Test Sections No. 4, No. 5, and No. 5a, and Test Section No. 6 was that far less water was required to obtain a saturated or near-saturated condition with the in situ crushed ice aggregate than with the snow.

Let's talk about the breakup history. Professor William Fuller of the University of Alaska and Phil Johnson, CRREL, inspected the road sections at various times through breakup. The first section to become unusable and, in fact, to disappear, was the conventional saturated snow road. The second ones to fail were the ice aggregate roads we put the most work and water into; Sections 4, 5, and 5a. These three sections were constructed in lifts of saturated ice aggregate. The sections that remained firm and serviceable longest were of the simplest construction.

On May 1 it was reported that Test Section No. 3 had melted down to about a one-foot thickness but was still firm.

Why did these sections hold up so well? The most likely answer is that they are more porous. As a consequence, water does not pond on the surface. Ponding increases the absorption of solar radiation. At all times the surface of the simple ice aggregate structures appears dry.

How easy is it to construct an ice aggregate road? We used standard construction equipment but did not work from the ice aggregate surface. A specialized piece of equipment will be required before that can be done. As mentioned earlier, it was found during the field test that just-placed ice aggregate will support a tracked vehicle with a ground pressure of at least 2.7 psi. It should be entirely feasible, therefore, to construct a low ground-pressure ice aggregate distributor and grader and a bond

water applicator which could operate directly from the just-placed ice aggregate.

It appears that at temperatures below 5°F, the sensible heat of the ice aggregate is sufficient to freeze back the water that is added to form the bond layer. The meaning of this is that at low temperatures, the time from placement to full utilization of the structure can be measured in minutes.

As for continuing research, we are most interested in learning just how much water is really needed to form a satisfactory wear layer. Also, how does ambient temperature affect bond water penetration?

We want to look more at the influence of ice aggregate gradation. Laboratory tests show that a very satisfactory structure can be constructed with as low as 10 percent of the gradation passing 2.5 mm. The aggregate gradation used in the field test ran as high as 30 percent passing 2.5 mm. The higher the percentage of fines, the greater the bond water requirement. It is known from lab tests, however, that some percentage of fines is necessary.

We don't know much about how ice crushes at different temperatures and whether the gradation will change with the same crusher geometry.

We're also very interested in bond water freeze-back rates, because they affect the design of equipment to be used for continuous construction from the structure itself.

We're also interested in what diurnal temperature variations may do in the long term.

Is creep failure under long-term loads possible? We want to look at the possibility.

Some of these tests have already been started. Others are still in the design stage. We hope to know something about all of them in the next six months or so.

Low Ground-Pressure Vehicle Tests on the Arctic Slope

Charles W. Slaughter*

ABSTRACT

Terrain impact trials were conducted at Lonely and Prudhoe Bay in the summer of 1976. Three different vehicles (CATCO Rolligon, Houston Rolligon, and Nodwell personnel carrier) were used at Lonely. Plant disturbance and tundra compression measurements were made as a basis for quantifying impact. Only one vehicle (CATCO Rolligon) was used at Prudhoe. Two courses were laid out, mapped to transect the greatest possible variety of landscape units. Single and multiple passes were run. Measurements of plant and soil impact were then made. The sites are to be revisited next summer (1977) and additional measurements taken.

Full results of vehicle impact trials which were described at the 1977 Surface Protection Symposium have since been published: Walker, D. A., P. J. Webber, K. R. Everett, and J. Brown. 1977. The effects of low-pressure wheeled vehicles on plant communities and soils at Prudhoe Bay, Alaska. Special Report 77-17, USA Cold Regions Research and Engineering Laboratory, Hanover, N. H. 49 pp. and Everett, K. R., P. J. Webber, D. A. Walker, R. J. Parkinson, and J. Brown. In press. A geoecological mapping scheme for Alaskan coastal tundra. Proc. Third Int'l Permafrost Conf. Edmonton, Alberta. July 1977.

(continued)

*Dr. Slaughter is Principal Watershed Scientist, Institute of Northern Forestry, U. S. Forest Service, Fairbanks, Alaska.

While all resource development requires movement, the vehicle is only one factor in environmental impact. Operator sensitivity, route selection, policy questions, and interagency cooperation are among other factors that control impact.

State Air and Water Quality and Solid Waste Disposal Requirements

Larry Dietrick*

ABSTRACT
The Legislature, given the authority by the State Constitution, passed legislation in 1971 that resulted in the creation of the Department of Environmental Conservation. The declaration of policy, outlined in Title 46 of the Alaska Statutes, states the department objectives. To fulfill these objectives, the department has the power to adopt regulations and standards to protect the State's natural resources and environment and to control pollution. Recent changes in the penalty provisions have greatly increased the sums which may be assessed by a court. Some of the department's requirements are imposed as stipulations on land-use permits and others are imposed as regulations. A brief review is made of the history and basis for some of the department's requirements and of some of the special conditions which apply in the Arctic. New standards and guidelines which have evolved over the years, are discussed along with a number of areas with which the department is presently concerned. A summary is

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then made of progress at Prudhoe Bay with emphasis on new technologies and applications which are being used for solutions to old problems.

I have been asked to present an overview of what the Department of Environmental Conservation is doing on the Arctic Slope at this time. I prepared some material and did a little research as to when and how State guidelines and standards were developed.

The Legislature, given the authority by the State Constitution, passed legislation in 1971 which resulted in the creation of the Department of Environmental Conservation. Title 46 of the Alaska Statutes, Sec. 46.03.010, outlines the declaration of policy, which is "to conserve, improve, and protect the State's natural resources and environment and control water, land, and air pollution in order to enhance the health, safety, and welfare of the people of the State and their overall economic and social well-being."

The department may adopt regulations providing for the control, prevention, and abatement of air, water, and land pollution. These regulations may provide safeguard standards for petroleum and natural gas pipeline construction, operation, modification, or alteration; protection of public water supplies; collection and disposal of sewage and industrial wastes; collection and disposal of garbage, refuse, and other discarded solid materials from industrial, commercial, agricultural, or community operations; and naturally, it can adopt regulations for such other purposes as may be required.

There has been discussion concerning regulations, stipulations, and guidelines. It should be emphasized that some of the department's requirements are imposed as stipulations on land use permits and some are imposed as regulations. I think it is important to distinguish between them because violations of the regulations and the statutes are subject to heavy penalties.

Recent changes in the penalty provisions have greatly increased the sums which may be assessed by a Court. Civil action for pollution damages can result in not less than $500 nor more than $100,000, for the initial violation, nor more than $5,000 for each day thereafter on which the violation continues. These penalties are substantial so that it is to a person's benefit to expend monies for the planning, acquisition, siting, construction, installation, and

operation of facilities necessary to effect compliance with the standard violated, rather than not correct the deficiency and expend the same monies on fines.

Civil action may also be brought in the case of pollution by petroleum or its products and liability can be established for the direct and indirect costs associated with the abatement, containment, or removal of the pollutant and the restoration of the environment to its former state. In addition, there can be criminal penalties. Violators are subject to fines of up to $25,000 and costs of prosecution. Willful violations can, in addition, result in imprisonment for not more than one year. Other powers of the department allow it to issue compliance orders, file injunctions, and issue emergency orders as necessary.

The judicial review given yesterday adequately portrays the existing status of the different authorities involved in the Federal-State-local problem of who is involved and which regulations will apply where and when. There appears to be an awareness that jurisdictional disputes should be incidental to conducting operations in an environmentally sound manner. There seems to be a further belief that sound environmental operations should be addressed and practiced by all parties - Federal, State, and scientific groups as well as the industrial community or private sector.

The history and basis for the standards and guidelines used by the department are not new. Their formulation began in the 1960's prior to the existence of the department. Increasing knowledge and more advanced technology have led to the addition of some new standards and modifications of others. Basically, however, the underlying control, the arctic environment in this case, has not changed.

Some of the special conditions which apply in the Arctic and a brief review of the history and basis for some of the department's requirements may be helpful. Biological and chemical reduction of organic material proceeds slowly under low temperatures. Putrefaction and decomposition occur in cold regions under certain conditions, but the usual processes of decomposition do not appear to occur within the permafrost. Organic materials exposed on the ground surface or placed within shallow top layers of seasonally thawed ground decompose slowly. Permafrost and extended seasonal frost in cold regions interfere with

normal metabolic processes of the soil.

Domestic and industrial water supply is frequently scarce and in many places unavailable. Most of the Arctic Slope is only slightly above sea level and many ponds and lakes are brackish and unusable. Early guidelines required that all temporary or permanent sites and facilities, including camps and industrial operations, be served with an adequate and approved water supply, liquid and solid waste disposal system, and appropriate air pollution controls.

Any wastes discharged to waters of the State, including ground or surface waters, were required to meet the highest applicable use classification established by the Alaska Water Quality Standards. This was prior to the 1972 Amendments to the Water Pollution Control Act, which specified a minimum of secondary treatment.

All water supplies for drinking and culinary purposes had to conform to the 1962 U. S. Public Health Service Drinking Water Standards. Bacterial samples and monthly reports were also needed, as was plan review. These are all things that still go on today.

The assimilative capacity of cold region waters of the State was, and still is, not considered useful or available for dilution or treatment of wastes because of naturally occurring low dissolved oxygen levels under ice during wintertime. Degradation of water quality by siltation or erosion caused by construction activities in or adjacent to active streams was, and still is, prohibited. Occasionally, appropriate diversion or containment facilities were required. The addition of thermal discharges was likewise prohibited.

Burial of waste organic material where average soil temperatures exist at 26°F or less was not permitted. Cold region soils and waters were not considered sufficient to provide adequate processing in nature. All garbage, refuse, waste building materials, scrap iron, and other solid wastes were to be contained, controlled, and ultimately discharged in accordance with a plan for solid waste management approved by the State.

No unprocessed organic solid wastes could be discharged to land or waters of the State. All oily wastes had to be totally contained or disposed of through a properly designed and approved system.

Earthen structures called sewage stabilization ponds were not acceptable as a principal method of sewage treatment. All sewage effluents which constituted a source of infection were required to be effectively disinfected prior to discharge to the receiving environment.

It is interesting to note that most of the requirements just reviewed were formulated before the Prudhoe oil lease sale. Much of the work was done by Amos J. Alter, environmental research engineer for the Alaska Department of Health and Welfare. The Alaska Oil and Gas Association adopted these standards in 1969, and they have also been accepted by the geophysical operators.

With the more recent passage of the coastal environmental legislation, increased exploration, pipeline construction, and oil and gas production development, the basic requirements for proper management of air, water, and solid waste practices have been expanded. Current stipulations now include fish and wildlife, land-use, and construction activities.

Again, the Department of Environmental Conservation, under Title 46, has the authority to promulgate regulations for the following: marine and coastal zone management; permafrost and soils engineering; land use and urban development; and terrestrial ecology and environmental engineering. None of these have been promulgated to date. Most controls on these activities have been imposed as stipulations so they do not have the full effect that regulations do. It is interesting to note that if these regulations were promulgated, they would cover virtually the entire realm of the existing surface protection stipulations.

There are a number of areas with which we have been concerned recently. One is siltation caused from gravel mining, stream crossings, and other construction related activities. Siltation can result in a violation of the water quality standards.

Water supply is another concern. Conservation of fresh water resources in areas of large development such as Prudhoe has become critical in the past two years. Reductions in industrial water use and recycling could alleviate the water problem and possibly forestall the necessity to dig new large reservoirs.

There are documented experiences of treated waste water effluent being used in industrial applications on drill

rigs. The same is true for gray water. These processes emphasize the need for a good conservation policy for fresh water. The question of where the water is going to come from to maintain the pressure in the Prudhoe field has not been totally resolved yet, either. I understand, however, that use of salt water is being considered.

Flow tests are another activity with which we have been particularly concerned. Our data show that since 1974 approximately 139 million cubic feet of gas have been flared at the Arctic Slope. In addition, approximately 163,000 barrels, or more than six million gallons, of crude oil, have been openburned. The goal right now is to minimize and eventually eliminate these practices as standard operating procedures. Alternatives are available.

Spills are another concern. A recommendation was made this morning to set back camp facilities 1,500 feet from any waterways. Justification and support for this recommendation is exemplified by the number of fuel-saturated camp pads that exist in the pipeline corridor. In several cases a minimum setback requirement would have prevented the leachate from such pads from flowing directly into surface waters.

Disposal of oil-contaminated material after spills is also a problem, and the easiest solution seems to be to burn it. Of the more than 11,000 reported spills to date on the pipeline, a large portion were unavoidable. Many, however, were caused by less than good management and nonexistent waste oil handling practices. To date, over a million gallons of waste oil from pipeline operations have been recovered and placed back in the line. Alternatives to openburning include mechanical recovery, such as pumping and wringing out sorbent pads prior to incineration.

Another area of concern is in the use of mud pits and reserve pits. The goal is to minimize surface disturbance and prevent leaching. We hope to eliminate the use of mud pits where gravel is not available. Some innovations with these pits have been tried. Mud can be frozen back, and some compounds are available that can turn the muds into a hard concretelike substance. Some operators use closed mud systems, thereby reducing the materials to be disposed of to drill cuttings only.

Solid waste includes tires, batteries, vehicles, garbage, trash, and scrap metal. Their disposal is a problem that needs to be addressed, probably through a complete

waste management handling system. Many of the things in the Prudhoe area that are junk to one operator are like gold to another. With the price of materials and other factors, it is hard to understand why they throw out some of the things they do.

Other areas of concern are erosion control and protection of beaches, shorelines, islands, spits, and lagoons; surface transportation corridors; shore-based facilities, route selections, and access needs. There has been no discussion so far in these proceedings of the proposed Beaufort Sea lease sale, which is coming up shortly. The State has drafted stipulations for the lease sales. It is my understanding that the sale will be held jointly by the State and Federal Governments, although plans obviously are not complete. At any rate, the State has put together a draft copy of the proposed stipulations. Possibly there could be some further discussion on this at the work groups in the next couple of days.

I would like to point out that a substantial amount of progress is being made on the Arctic Slope. Prudhoe Bay is now thought by some to be the fourth or fifth largest city in the State. I think it pretty well foreshadows what is to come in Pet-4 should it get to the production development stage.

Significant progress has been made in solid waste disposal at Prudhoe recently. The Mukluk dump was closed March 31, 1977, and initial steps were taken to rehabilitate the site. Rehabilitation will be completed this summer. Before the dump was closed, all operators were asked to submit a plan for alternate methods of disposal for all of the solid wastes that they generate. A variety of plans was submitted. The majority of operators are going to use incineration to dispose of the bulk of their waste. Some are compacting their refuse; and still others are actually backhauling their wastes, in one case as far as Anchorage. Other companies are grinding their putrescible material and sending it out to the sewage treatment plant, where it is later incinerated. There are also two cases where gas flares are being used to reduce the volume of bulky combustible materials.

Just this winter the concept of incorporating solid waste into camp pads was approved. There are two reasons behind this. One is to minimize surface disturbance for the creation of special solid waste sites, and the other is to minimize gravel use. In one instance, an entire drill

pad will be made out of solid waste. It is going to consist primarily of incinerator ash and residue and small pieces of scrap iron metal, all of which will be compacted to support the operations that will take place on top. The solid waste itself will be placed on top of a one-foot layer of gravel which rests directly on top of the tundra. Two reasons for this are to prevent mechanical damage to the tundra and to keep the solid waste material up out of any surface water. Solid wastes will then be compacted into a two-foot layer. This is followed by a final two-foot layer of gravel which will act as cover The end result is a usable five-foot-thick pad. It is possible that this technique could be expanded for use in roads and other camp pads.

Ocean dumping has been proposed but hasn't been looked upon favorably, at least by our group, at this point.

Cartridge filters are now commonly used for treating gray water prior to discharging directly to the surface. Gray water and treated waste waters have been successfully used for mud makeup water. It is strange that in one case an operator has used treated effluent from the sewage treatment plant for the mud makeup; yet other operators have not done this because of possible labor problems. It appears that, in most cases, the treated effluent water is a better makeup water for the mud than water from other sources.

A closed system was tried this season for total mechanical solids removal. Again, water was a problem. Snow melters and used gray water were used for the makeup water. By using a closed system to conserve water, the operators found they could greatly reduce the amount of mud they had to add to the system. This greatly reduced the amount of mud which had to be hauled to the drill site, which in turn resulted in a lower cost of operation. The system has been fairly successful, and it looks as if it might indicate what is to come in the future.

Wastewater disposal down shotholes has also been used. Direct discharge of sewage effluent to tundra depressions is being looked at, and in some cases, may be preferable to the construction of lagoons for which you have to disrupt more surface to find gravel to build a dike. Incinerator-type toilets and propane-fired toilets are in common use.

It was originally thought that each of the Prudhoe development wells would have to be flowtested and flared.

This would have made a substantial air pollution problem. Some of the worst air problems in the State are attributable to flow tests. The Juneau air quality staff has been working closely with the major operators at Prudhoe. They have reduced the number of flares needed for the development field to four. In most cases, the wells will be perforated and cleaned up and fluids will flow to the gathering centers or flow stations. Two experimental burners were used this winter to see if they could take care of contaminated diesel and calcium chloride solutions. They were generally fairly successful. The operational problems were quite complex, however, and it was difficult to keep the burners going. When they did burn, however, they burned fairly clean, and air quality stayed within acceptable criteria.

Liquid air curtain incinerators are also being studied as a means for disposing of well test fluids. Their use may make it possible for exploratory operations to eliminate flaring. The Canadians have been using these incinerators, and at least one operator in Alaska has contacted them and viewed the incinerator.

Other alternatives for the disposal of well test fluids are perforation and injection into another strata. There are some problems with the process. It has been done, but it is not known if it can be done consistently. Deep-well injection is commonly practiced at Prudhoe to solve waste fluid problems there and along the pipeline. There are other options for offshore rigs, such as loading wastes onto barges or tankers.

Waste oil disposal is another problem area. It is hoped that this problem may be solved, at least at Prudhoe and along the corridor, by injecting the waste oil back into the pipeline.

Last, but not least, this winter we saw the successful completion of a drilling operation on an ice structure.

In summary, it is clear that the majority of environmental requirements are not new. Most of them were developed and in effect at the time of discovery of oil at Prudhoe Bay. Some new standards and guidelines have evolved over the years and advanced technology is now lending new solutions to some old problems. Enforcement has also gained momentum and its growing appearance frequently leads some to believe that certain environmental requirements are brand new and too restrictive Such is not the case.

Sound environmental requirements, whether they take the form of stipulations, guidelines, or regulations, should be reasonable, specific, and backed up with an adequate enforcement program.

MR. LONNIE BROOKS: In respect to solid waste treatment, you stated that progress had been made at Prudhoe, and that some operators are incinerating solid waste and some are hauling it out, some as far as Anchorage. I have two questions. One -- what is being done with the incinerator residue? Two -- in what sense do you think that hauling it from Prudhoe to Anchorage is progress?

MR. DIETRICK: The incinerator residue is being handled in gravel pads right now. We have approved a number of these. The largest one approved so far has been an entire development pad. The other operators generally have fairly small incinerators -- 150 to 200 pounds -- and their volume is fairly small. In those situations they are incorporating incinerator residue into a parking area or some similar situation on the camp pad. As far as progress via backhauling it to Anchorage -- is your question, "Is that progress?"

MR. BROOKS: Yes.

MR. DIETRICK: I think that is a matter for each operator to decide on an economic basis for himself. We approach it from the standpoint that solid waste problems are handled in a number of ways. In this case, the operator took this option, although he could have gone to a small incinerator. It is definitely progress from the standpoint that the Mukluk dump, which was located in the active flood plain of the Sag River on unleased State lands, is now closed.

The Role of Research in Developing Surface Protection Measures for the Arctic Slope of Alaska

Philip R. Johnson*

ABSTRACT
The U. S. Army Cold Regions Research and Engineering Laboratory (USA CRREL) has long conducted research in snow, ice, and permafrost. It also translates foreign language engineering papers and publishes research reports, monographs, and bibliographies. Snow and ice roads and construction pads have been used, primarily on the Arctic Slope, during the last few winters. Some have been successful but problems exist which will require further experience and research to solve. One problem is that of snow supply. Snowfall on the Arctic Slope is limited, particularly early in the season when it is most desired. Few good data are available on total quantities and the time pattern of snowfall but Wyoming Snow Gages, now being installed by a number of government agencies and private organizations, are beginning to provide some data which can be used with some confidence. The snow which falls is often blown off by the strong winds which are common in the area so it is not available where it is needed.

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Research is under way on equipment and techniques for collecting snow and inducing drifting.

The U. S. Army Cold Regions Research and Engineering Laboratory (CRREL) has been involved actively in the general areas of snow, ice, and permafrost research since the late 1940's. In the 1950's CRREL investigators were actively and deeply involved in the construction and use of snow roads, airfields, and buildings on deep snow fields on the Greenland Ice Cap. Later, the deep snow work shifted to Antarctica, and the Naval Engineering Laboratory at Port Hueneme was principally responsible for similar work, with CRREL's assistance.

CRREL still is active in developing snow and ice testing equipment. The laboratory also translates foreign papers (particularly Russian) in the engineering area and publishes a number of types of publications including research reports, a monograph series which is designed to summarize existing knowledge in various fields, and the Bibliography on Cold Regions Science and Technology, which formerly was the Bibliography on Snow, Ice, and Permafrost.

CRREL interest in the use of snow and ice decreased in the 1960's but has revived with the discovery of oil in the Prudhoe Bay region and construction of the trans-Alaska oil pipeline. Snow and ice roads are being pushed as the solution to many problems by some groups. They have not been universally successful, however. Their limitations and further development required to overcome these limitations have not been fully identified.

In the last two years, Alyeska Pipeline Service Company has used snow pads for construction on the Arctic Slope. The general temperature pattern indicates that the pads should remain functional and usable well into May, particularly near the Arctic Ocean. I was up there on April 25, 1977, and the area was experiencing an unseasonable thaw. The snow pads to within two miles of the Arctic Ocean had essentially melted. A construction schedule, based on use of these pads, could have been in serious trouble. This was the second year that this happened. In 1976 unseasonable weather in the Toolik and Galbraith area also caused loss of the snow pads at the end of April.

It must be recognized that snow and ice structures are transient and vulnerable to unseasonable weather, even on the Arctic Slope of Alaska. Research can help identify and quantify the uncertainties and provide guidance for the

user. Technological development can provide facilities which are more resistant to an occasional melting period. This is one reason the ice aggregate road tested by Ed Fisher and Arctic Gas is promising. It appears to be less affected by early melting than is a snow road.

Exploration in the PET-4 area this past winter was hampered by lack of snow--a problem also experienced by Alyeska. Snowfall in the area is light and the quantities available during the early winter--October to December--were inadequate to allow the construction of snow trails and the use of conventional equipment. The strong winds blow many areas essentially clear of snow even if a substantial quantity does fall.

The first question that arises in considering snow roads is that of the quantities of snow which fall and their distribution in time. Dr. Carl Benson [University of Alaska] and others have demonstrated that snowfall data obtained from National Weather Service stations in this windy area understate the total snowfall substantially due to the high winds which commonly accompany the snow. Within the past two years, Arctic Gas, the Soil Conservation Service and, more recently, CRREL, have installed Wyoming Snow Gages, which are specially designed snow gages for windy environments.

This past winter, for the first time, Wyoming Snow Gage data have been available for a number of sites. These are at Point Barrow, Barter Island, Kavik, Jago River, Meade River, Prudhoe Bay, Sagwon, and Toolik. They show that all sites had four to five inches of snowfall, water equivalent, this past winter. Unfortunately, the data collection system for these widely scattered gages does not obtain detailed information during the late fall and early winter--the period of most interest to those considering snow roads.

I have proposed to Husky Oil that CRREL install one Wyoming Snow Gage at Lonely this summer and read it daily to get a better indication as to the distribution in time of snowfall. Such information would be useful in estimating when operations can begin on the tundra.

My observations are that the early snow that falls on the tundra is trapped in the tundra vegetation which is four to six inches high. Additional snow that falls is usually blown about by the wind until it is trapped by various topographic features such as streambeds.

We are interested now in developing means of collecting the snow that is trapped in the tundra so it can be used to initiate a snow road. Currently CRREL has developed a concept of a device which might work. Mounted on a Rolligon, it would use a compressor and suitable nozzles and shrouding. The Rolligon, crossing the tundra, would crush and pulverize the snow. A high-pressure air system with a number of nozzles would blow the crushed snow out of the vegetation while a high-volume fan would provide airflow to drift it to the side. When passes are made on both sides of a proposed trail with this machine, enough snow might be collected to begin a snow trail.

Second, we have developed a light folding snow fence which appears to be self stable. Made from a steel frame and fabric covering, this fence can probably be manufactured, transported, and erected cheaply enough to make it feasible to use to initiate drifting and thus build a snow trail. This fence will be developed further and tested soon.

The ice aggregate road developed and described here by Ed Fisher is a technological breakthrough. I observed his test road during the winter and spring and was extremely impressed with his method of mining ice and building an extremely reliable road. This ice aggregate road is the counterpart of the paved highway, with the ice aggregate replacing the gravel fill and the paving formed by bonding the upper surface with water. It should be suitable for heavy hauling. It undoubtedly will be more expensive than most types of snow and ice roads due to the cost of obtaining and hauling the ice aggregate. Consequently, it provides the strong, higher-cost winter road or construction pad.

An important advantage of the ice aggregate road is that it will undoubtedly inspire more confidence than snow roads. Engineers and others will understand and trust this type of road which is not as foreign to Lower 48 experience as is a snow road.

In summary, snow and ice roads and other facilities have a limited history in northern Alaska. In some cases they have been satisfactory; in other cases problems have developed. Experience and research have made contributions to improving the reliability of these facilities but further work is required.

Summary

Edwin M. Rhoads

I would like to pass on some of my observations on the role of research and development in developing surface protection information. Yesterday, Dr. Gal made a significant point in his talk about archeological exploration in conjunction with construction activities on the Arctic Slope. He pointed out the necessity for each side, research and industry, to understand the techniques, methods, and problems of the other side. I think that dialogue and communication between the research and development community and the operations people are extremely important.

In between these two groups come the regulation people who have to take the research and development data and prescribe stipulations that the operator has to live with. The operator on the other hand has a job to do, and he doesn't want any more obstructions in his way. He's got enough of them from the elements, his stockholders, and his timetable as it is.

I would like to cite a brief example from military history in this regard. Napoleon kept a sergeant on his staff all the time. The sergeant went everywhere Napoleon did. A visitor to Napoleon's headquarters heard the Emperor issuing the orders for his field commanders to the sergeant. The visitor asked Napoleon why he did this. Napoleon said, "I chose the sergeant for this particular purpose: I issue all of my orders to him. If he understands them, I know that my field marshals can understand them."

I want to summarize a few basic tasks which I think are essential to the role of research and development.

The first, specifically pointed out by Oscar Ferrians, is the need to collect, record, analyze, and define baseline data. This is a fundamental, primary step in basic research, and it carries through applied research and development.

Second is the need to develop operational techniques, to improve the capabilities for winter operations as well as year around operations. We need to develop new technology and apply it to work in the Arctic.

The third task, probably the most difficult job that research and development has, has always had, and always will have, is to improve prediction techniques. What are the impacts going to be 10, 20, or 30 years from now? The long-range prediction, a crucial element, is equally as crucial to the operators as to research and development staff. The immediate short-range predictions also are needed. We need to know such things as when freeze-up will occur, when there will be enough snowfall for making snow pads, and when breakup will occur. Microclimatic predictions, I think, will have a substantial role in research and development.

A fourth need is to refine and clarify requirements for stipulating regulations. These regulations must be workable, and they must give real alternatives to the operators, because no one solution, no one regulation can apply over all.

Again, as Oscar Ferrians pointed out, surface management--not surface protection--is the approach that ought to be taken.

Finally, I feel that research and development should be responsible for feedback and followup. We are going to live with what is being done now for many, many years. It is absolutely essential that the research and development community be prepared to provide long-range followup and continuous feedback so that the research and development can be improved.

I hope these suggestions will provide some guidance for the workshops in the next few days.

Editor's note: A paper, "Winter Off Road Transport in Northern Alaska," presented by Mr. Rhoads at the U. S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire, on February 25, 1977, is reprinted in these proceedings as Appendix A.

WORKSHOP REPORTS

An Interdisciplinary Review of Existing and Proposed Stipulations for Protection of Existing Values on the Arctic Slope of Alaska

Theme: Are there common threats? What are proper surface protection measures for summer operations?

Introduction : Jules V. Tileston

Are State, Federal, and local surface protection stipulations uniformly applied across the Arctic? If not, why? To what extent should exploration and nonexploration activities on the Arctic Slope be restricted during the summer?

The Prudhoe Bay Field now is operational. Development wells and some exploratory wells are being drilled. Construction of a gas pipeline is imminent. Off-shore leasing in the Beaufort Sea of State and Federal submerged lands for oil and gas exploration is expected in 1979. Exploration for oil and gas on NPR-A (PET-4) will move inland from the Arctic Coastal Plain. This will require year-round logistics and work in areas where activities now are absent or confined primarily to the winter. The Arctic Slope Regional Corporation will explore its subsurface ownership. Numerous land-use and scientific studies are under way or proposed at times and places where wildlife populations are at sensitive stages.

Congress has directed that exploration for oil and gas within NPR-A continue and that development of the South

Barrow gas field proceed. Responsibility for protection of the natural, fish and wildlife, scenic, and historical values rests with BLM. Development of the South Barrow gas field and oil and gas exploration rests with USGS. Although Congress directed exploration for oil and gas throughout NPR-A, it requires "maximum protection" of existing values within special areas such as Utukok, Teshepuk Lake, and Colville River portions of the Reserve. These special measures are to take into account subsistence requirements and resident and migratory wildlife needs. Exploration activities are to take place during times of the year other than caribou calving season and bird nesting and molting seasons.

Numerous proposals have been made on how best to protect existing values on the Arctic Slope. Foremost is the responsibility to maintain subsistence requirements for rural Alaskans who depend upon fish and wildlife which in turn depend upon arctic habitats. There is agreement that the Arctic Slope requires special measures; there is no agreement on which special measures are proper from the social, environmental, economic, and technical aspects. A major reason for lack of agreement is that biologists tend to talk to biologists, engineers to engineers, etc., with little interaction until after positions are firm and factions polarized. The workshop is intentionally designed, therefore, to encourage interdisciplinary-interagency discussion.

Objectives and Goals

The objective of the workshop was to review existing and proposed Federal, State, and local surface protection requirements that apply to the Arctic Slope of Alaska. Members of each workshop group were specialists in various disciplines so that each topic was reviewed from major but sometimes different viewpoints.

The goal of the workshop was to: 1. determine if there are major inconsistencies or gaps in surface protection measures; and 2. identify potential solutions with special attention to summer activities on the Alaskan Arctic Slope.

Organization and Reporting

The workshop was divided into the following groups: General Guidelines; Wildlife; Fisheries; Air and Water Quality; and Technical Considerations. Symposium partici-

pants were assigned to each work group according to their special knowledge and were given suggested topics and areas and background materials. Each work group was expected to modify or expand its membership and topics.

On May 20, 1977, work groups assembled and each work group chairman reported his group's conclusions and recommendations. There was opportunity to discuss work group findings.

The following are the workshop reports, edited for publication in the proceedings. The reports will become the basis for public review and comment. On the basis of public review and comment, BLM will modify and/or adopt those surface management measures applicable to lands it administers on the Alaska Arctic Slope.

General Guidelines

Report: William J. Moses, Chairman

After listening to the first speaker this morning, I think that the members of our work group may feel that some of the other work groups actually had topics they could sink their teeth into. Perhaps their recommendations are a little more meaningful than those that came from our workshop.

We approached the problem rather literally and limited our points to the so-called general approach of the stipulations. We did not attempt to get into such things as seismic considerations. Some of the people in our group had comments they would like to have made. If that subject is not covered in other workshop reports, I think at least one of the men of our group may have some comments specifically on seismic and perhaps other topics.

We discovered that our attempt to look at substantive points that we could agree on and avoid the jurisdictional morass simply was not successful. We concluded yesterday afternoon by listing a basic approach to the general stipulations. I'd like to cover four problems and I think that you will see what we were faced with in coming up with a set of guidelines or stipulations to apply across the Arctic.

The first basic problem is clearing the jurisdictional morass. I think that the consensus of those of us who lasted until late in the afternoon was that if jurisdictional confusion could be cleared up, many problems of

writing a set of acceptable stipulations or guidelines would be solved. The jurisdictional morass is at this point a State-Federal problem, but as those of you who heard the representative of Mayor Hopson know, it could become a tri-party problem if the local government adds its own regulations, ordinances, or the like.

The second basic need in an approach to a workable set of general stipulations is to establish a single governmental authority. At the very least, coordination within the respective governments would be helpful. For example, coordination within the Federal establishment and similarly within the State establishment, and perhaps some sort of cooperative agreement, a memorandum of understanding, or something of this nature would guarantee that at least permittees, lessees, industry, or third parties in general would know who they have to contact. Perhaps some are even naively hoping for a single government contact for various authorizations, credits, clearances, approvals, and the like.

The third need was the establishment of priorities or objectives. This ties into the first two points, the jurisdictional confusion and establishing of a focal point in government. In some cases, priorities and objectives may be set by either State or Federal legislation in which Congress or the State Legislature sets forth the legislative intent and purpose for authorizing certain activities.

On the Trans-Alaska Pipeline System, (TAPS), Congress made a statement that as a matter of national policy the trans-Alaska pipeline would be built without administrative delay. So priority was established by Congress in that case. In PET-4 legislation there is an indication also of national priority, but PET-4 does not make up all of the Arctic Slope.

I think that one of the frustrations which became evident in our workshop was that without a statement of priorities, it becomes very difficult to work out a meaningful set of stipulations or guidelines.

The last point in the basic approach was that a set of stipulations, to become workable, must to some degree apply to site-specific problems. Stipulations such as those used for the TAPS project, whether they were State or Federal, were tied into a certain type of project. The same sort of stipulations may not necessarily work as a general guide to cover all types of activity across an area such as the

Arctic. By this I mean we have problems with regard to what may be a national priority in PET-4. I anticipate we will have the same sort of statement of national priorities and policies upon implementation of a gas line. But those statutes, whether State or Federal, will on the whole be directed toward a particular project. Stipulations in those circumstances could then be directed toward such a project but would not necessarily be the sort of stipulations that you would want in a broader context to cover all activities in the Arctic.

We had a lot of discussion--some of it bordering on the philosophical--that tended to show our own prejudices, developed over a number of years on the TAPS project. We did come up with a basic question: Why have stipulations?

I think that our work group suggested at least three answers to that question. Stipulations are needed for the following reasons:

1. To make clear exactly what is expected of both the permittee or the lessee, as well as the permitting agency.

2. To insure that their own legal requirements are to be met by the permitting agency as well as the permittee.

3. To provide standards and a process by which the permittee's actions may be evaluated and monitored.

What then is the recurring point here? There was a feeling within the work group that the stipulations, requirements, and the like actually run both ways, that in setting up standards and criteria, or special conditions, stipulations or the like, there is a responsibility on the part of government to make sure that it also meets those stipulations.

A concrete example was discussed with respect to environmental training, one of the general stipulations found in both the State and Federal stipulations for the TAPS project. The point was made that it is incumbent not merely on the permittee or user of Federal, State, or private lands on the Arctic Slope to provide environmental training sessions for its own supervisory and managerial personnel, but also for the working employee. Government overseers, monitors, inspectors, and the like also should be qualified, and be able to demonstrate experience in the type of activity that they are in fact called upon by State or Federal law to oversee.

Some very practical problems must be recognized in this area. With its policy of rotating its employees in and out of Alaska, the Federal Government often defeats any attempt to maintain or develop regulatory expertise. The State government also has a large turnover. People who become experts in a particular State agency leave either to go out on their own or to the Federal Government or industry. If we are going to have workable stipulations, we've got to make sure that on the government's side we have a degree of competence that in the past was not always present.

I think that those in our work group felt that if the four basic problems I mentioned earlier are solved--clarification of the jurisdictional situation; establishment of a single governmental focal point; establishment of priorities whether through legislation or a statement of priorities in the basic document itself; and keying stipulations to a site-specific situation--the general approach to stipulations is not difficult. Certainly the general approach, such as the TAPS authorizations for both the State and Federal Government, is workable, subject to some modifications that I'll mention. But drawing up general provisions and stipulations is not difficult if we can address and handle the really big problems.

For example, if we know that jurisdiction over certain environmental matters is lodged in a single governmental entity, we don't need to start looking at other governmental entities to see how they may feel about the matter. Presumably, whatever information they may be able to provide will have been given to the appropriate governmental entity. This will eliminate the problem of a number of government agencies each trying to get a "piece of the action."

In some specific areas we felt that the general approach, evidenced in the TAPS stipulations, could be improved.

We felt that these stipulations should have an appeals procedure within them. In other words, a means should be provided for administering and reviewing a decision made by a governmental representative, by a higher level within the government, so that many of the problems between the permittee or lessee and the government could be resolved short of litigation.

Another point that was discussed, and I think there was a consensus that some changes should be made, is in the provision of the general stipulations used by both the State

and Federal Government on TAPS regarding changes in the stipulations. That provision as presently worded ties the right to change or modify the stipulation to reasons that are environmental, or that may affect public health and safety. In the session it was pointed out that if in fact the technical and environmental stipulations represent a "state of the art" approach, (which the TAPS ones certainly do), and presumably many of the suggestions I heard this morning are state of the art type things, then no new situations may come up over the life of a particular land use authorization in which it becomes apparent that the stipulations could logically be changed, not necessarily for an environmentally better breakthrough, but because of a way of doing it, a new state of the art, has indicated it is cheaper to do it another way. To some extent the technical stipulations have a redundancy built into them. For example, there may be a situation in which the stipulations provide for a certain approach to stream crossings and the design and operating plans indicate that the permittee intended to approach all stream crossings in a certain manner. After two or three years of operation, situations arise in which the state of the art indicates there is a better way of doing things. You cannot honestly say that it is environmentally any better. Perhaps it is better simply because you can do it in a shorter period of time and it costs less money. The government accrues intangible values in not having the activity continue as long as it would have under the original stipulations. Some way of changing stipulations is needed that is not limited merely to environmental, public health, and safety criteria.

We then came to a number of issues that are open issues as far as our work group was concerned. The first of these is the "go or no-go" authority of the man in the field. We explained this issue as follows: The man in the field has to have the authority to stop certain activities if in his opinion a violation of the stipulations has occurred or if conditions change and damage to the environment inadvertently occurs.

As our work group looked at it, however, the problem is whether or not the same man in the field who has the authority to curtail activities also should have the authority to "buy-off" on a particular activity to satisfy government requirements and not have someone higher in the government come back, second guess the situation, and say "Even if Joe in the field says it's okay, I think we want it redone." This was a real problem for the people in our work group. Some felt strongly that the authority should run

both ways, that government should have confidence in the man in the field. If you have enough confidence in him to give him the authority to stop the activity, you should also have enough confidence for him to approve a particular activity once and for all for the government.

I think we may tend to overlook the question of whether it is realistic to expect that government will give the same latitude to the man in the field to approve on its behalf the particular activities, as it will give to disapprove. This gets to the basics of what is the function of the government monitor. Is he out there to spot a mistake and stop it, or is he out there to "buy-off" on some particular activity? Our work group has no answer to that.

Next, we had some questions on regular general stipulations. As most of you know, under the Federal-State TAPS authorizations the Notice to Proceed was a device to control the permittee or lessee from commencing construction on an area of land authorized for certain activities until in fact the government had issued detailed conditions and instructions and was satisfied that construction could go ahead. It was a control mechanism.

Here again there was a little dissension within the group. Some felt this procedure should be used as a general approach in stipulations. Others thought the plans for construction by the permittee or lessee should be reviewed long before the authorization was granted, so that once the authorization was granted, the permittee or lessee could schedule his activities based on his own needs and the basic requirements of the stipulations and not have to come back for further details, plans, and specifications to meet the approval of the authorizing governmental office.

On another subject we had a suggested revision of the general stipulations on archeology. Basically, this provision was a consensus of two since the rest of us don't have much expertise in the area. The suggestion had been made that the language used in the original stipulations by the State and Federal Governments for TAPS came out shortly before a set of Federal regulations came out with detailed procedures, and therefore, by referencing the applicable statutes and regulations such as 36 CFR 5800, the 1906 Act, and the 1974 Archeological Historic Preservation Act, you could refer the permittee directly to the applicable statutes and procedures. Here, again, we come to one of these major questions regarding the purpose of the stipulations. Is the purpose of the stipulation merely to

refer the permittee to various statutes or regulations or to pick up where this particular statute or regulation ends and give specific guidance to the permittee?

In this particular area our experts on cultural resources indicated that the regulations are in fact quite specific. The directive was set forth in the regulations. Therefore, in this type of situation the pertinent procedure is simply to collect the applicable statutes and regulations and cite them to the operator or land user.

I mentioned earlier the question of environmental training. Here's an area where we felt that the stipulations used by the State and Federal Governments for TAPS actually were not the best stipulations available. More detailed stipulations on this are found in the general environmental and technical terms and conditions proposed by the Federal Power Commission in its recommendation to the President on the Alaska Natural Gas Transportation System.

These stipulations contain a two-level environmental training program. Subsection 1 of the FPC stipulations required the applicant to prepare a continuing technical environmental briefing program for supervisory and managerial personnel and its agents, contractors, and subcontractors, with briefings conducted by environmental experts with Federal, State, and local agencies as well as the applicants. Also required are training in problem solving and exchange of ideas.

The second tier of the training program is a mandatory program to inform each person working on the project the specific aspects of environmental concerns which relate to the individual's job. The training program is to be designed and administered by qualified instructors experienced in each person's field. Every available method is to be employed to see that the project is carried out, using the highest techniques necessary to prepare for consideration of the technological, geological, and biological resources.

This program is to be coordinated with the first tier of technical environmental briefing program for managerial and supervisory personnel.

The only additional language that was discussed on this aspect of the program was a statement to the effect that the cost of the program should be borne by the permittee or lessee. In this regard, however, such language may not be

necessary, depending upon whether or not there is a specific statute setting forth the basic priorities and objectives. For example, if the Alaska Natural Gas Act sets forth the fact that this is to be a reimbursable expense to the government, there's no problem. We did see a problem in attempting to put specific language regarding reimbursement into a general set of stipulations that was intended to cover all activities on the Arctic Slope. You could get into a situation in which a relatively small group of private parties in commercial activities, such as a guided Sierra Club group on a six-week summer tour of the Arctic Slope, could find themselves required to provide a briefing of this sort. There must be some cutoff point. Perhaps such questions as reimbursement may well be covered within the applicable statute.

Aside from the jurisdictional questions of whether or not the general stipulations should cover subsistence, I believe the feeling of the group may be summarized as follows: Part of the group felt that the question of subsistence should not be touched at all in the general stipulations. Part of the group felt that it should be addressed, but only in general terms. A suggestion was made for language to the effect that permittees should avoid all areas used by local area residents for hunting, fishing, and gathering areas of birds. There are some very real problems in using specific language. At the most, if there were to be some language in general stipulations regarding interference with subsistence activities, it should be kept very general. Perhaps the exact language of any applicable statute should be specifically incorporated into the stipulations in this regard.

We also touched briefly on the problem of what to do about environmental equipment training for poorly qualified individuals. My thought on that point was that this perhaps is something that government itself will have to get into. Demonstration of expertise may have to be required. I would be very leery of getting into this area, and I'm not sure that anyone else is willing to get into it. It is different with regular employees of the permittee or one of the contractors or subcontractors. Certainly, under an environmental training briefing program, they trained with good results. But I am thinking more of truck drivers who operate as common carriers brining fuel up the Prudhoe Bay road. Many of the spills mentioned this morning took place with this kind of carrier; they did not take place on the workpad or the industrial area.

MR. JOHN SANTORA: When you were discussing roles of people in the field and the activities they engage in with reference to the work that is going on, did you differentiate between the role of the monitor as opposed to the inspector? In my mind their roles are very different.

MR. MOSES: I think this is part of the fundamental question of what really is the governmental role to be followed with respect to activities of third parties on the Arctic Slope. Is the role simply that of a regulatory official, or simply managerial in the planning stage? This says nothing about whether or not it's being done correctly. Those of us who are bureaucrats realize that in the real world of government, hardly anyone ever gets fired for saying, "Stop." But if you go out and say, "Yes, you've done it correctly," several weeks later you may find yourself transferred or fired if you don't have Civil Service protection or the like. Therefore, there is a built-in reluctance on the part of government people to be put in the position of having to actually approve something. They would rather pass the buck along to people higher up in the line. If the man in the field had the basic confidence in the first place and is trained, there's a strong argument that you should feel he's good enough to "buy-off" for the government. But going back to the real world of bureaucrats, he may just surprise you. We don't know.

MR. BILL COPELAND: Another point we discussed was the need in general government guidelines to have a general stipulation that the permittee designate who his authorized contact is. A lot of times the agencies go to industry and talk with one person, then another, and the next time another, all on the same subject. It is also important for the permittee to indicate who his field contact is.

MR. MOSES: That's correct. For example, we built language into the State and Federal TAPS agreements that says Alyeska Pipeline Service Company is the general agent for the permittees or lessese for the TAPS project. That certainly directs us to Alyeska Pipeline Service Company. Within an organization that large, however, there also is the problem of who is speaking for whom--whether you should contact the Lands and Legal Department, the Engineering Department, Designs or Environmental, Quality Control, Quality Assurance, and right on down the line. What, in fact, is the authority of the particular person you're talking to? I might point out that the Department of the Interior on that project also had responsibility for enforcing Civil Rights and Equal Opportunity provisions.

Part of the plan that we required from the permittee companies through their agent Alyeska was a detailed chain-of-command on Equal Opportunity matters. Thus, one of the EEO investigators knew exactly where the chain-of-command, the industry counterpart, would be. People in the regional office of the EEO office knew that when they were contacting certain individuals in a certain position, that position reported through a known chain-of-command in the permittee organization.

I think that on a non-EEO-civil rights plane, this sort of breakdown for identification of the chain-of-command within a large permittee organization is helpful. It does not necessarily have to be set forth in the stipulations, but the stipulations could provide that upon request of government, a designation of chain-of-command on certain matters will be provided. Then, in an emergency situation, one would contact a certain level of authority within the permittee organization.

Wildlife

Questions for Group Consideration

What is needed to protect arctic wildlife in remote areas, especially caribou when calving, musk oxen, polar bears, peregrine falcons, and waterfowl, from disturbances caused by human activities? Should sport hunting be restricted? Firearms? How does aircraft noise affect animals? What is the season of greatest sensitivity and where? Should there be flight altitude-lateral distance restrictions during those periods and at what places? Should there be exceptions for scientific investigations or for management purposes? Do bird counts affect caribou? What is the difference between harassment level of bird counts and that of other required scientific or land-use studies and exploration activities? What is the threshold level and is it commutative? How can the threshold level for a species be determined, and what happens to the species if the level is exceeded? How should use be rationed when requirements exceed threshold of harassment? Which programs should proceed and which be delayed? Why?

The group was given the following background data: Arctic Gas noise studies; Canadian environmental recommendations; Climatological data--i.e., how bad is weather, where during "summer"?; Flight restrictions at Sagwon for peregrines; Recommendations of peregrine falcon recovery team (preliminary); Arctic National Wildlife Range stipulations.

REPORT: Scott Grundy, Chairman
Alaska Department of Fish and Game Biologist
Fairbanks, Alaska

The Wildlife Group was interesting and included some industry people and the usual conservative biologists. I found that some of the industry people of our group were far more conservative than I am, however.

We restricted our suggestions. Most of us have been through

this before, and we know just how abstract we can get in restricting our activities. We restricted our suggestions to summer activities that are likely to occur predominantly within PET-4.

I am pleased to see the stress in the theme for flexibility and stipulation approach. Stipulations should be specific, of course, in order to be understandable and enforceable. On the other hand, you have to have a rear door--it bothers me to see us back ourselves or industry into a corner because we have a very specific stipulation and as bureaucrats we say, "Well, it said..." The theme that I'd like to continue is that stipulations have a purpose and they should be reasonable and workable.

It also distresses me to see industry go out of its way and spend large sums of money to satisfy the "environmental protectionists." In one instance, an operator west of the Kuparuk River in Prudhoe was paying high rental on about 25 pieces of equipment. I happened to be there when he was complaining about it, and I said, "Why didn't you apply for a permit to cross this shallow ripple of the Kuparuk?" He answered, "I didn't think it would be approved."

It's this type of thing--communications--that is lacking. The group recommended environmental briefings and I think the point I just made can be stressed. If you can't work with it please tell us, as we do wish to be reasonable.

One of the issues we tackled was waterfowl stipulations. I'll paraphrase those recommended to date:

No surface vehicle access in critical molting or staging areas, 500 feet overland, during the period of May 20 to August 25 in areas north of 70° north latitude, which is essentially the Arctic Coastal Plains.

Another problem the group discussed was that the 500-foot restriction was inadequate, especially in a truly critical area. The group also felt that there was quite a difference in reaction of most animals (waterbirds included) to helicopters and to fixed-wing aircraft. On the other hand, the requirement of more than 500 feet would essentially close the area to human activity during most of the summer months.

We recommended that the Arctic Gas evaluations on the responses of waterfowl on various lakes and the persistence of aircraft be reviewed. Essentially their recommendation is that all point-to-point flights occur at a 2,000-foot elevation. They found that snow geese respond by flushing to either a helicopter or a fixed wing aircraft when it passed at an elevation

of 10,000 feet. They would also respond to aircraft that passed within two or three miles. Essentially what you have to do is to prohibit all aircraft use within that area, and I think the key would be the frequency. These populations can probably sustain some disturbance, but management should allow as little disturbance as possible. One of the group, Dr. Francis, said, "Perhaps we can look at these areas as mountains. Aircraft fly around the mountains. They can also skirt around such critical areas as they are identified."

The Big Barrier Islands offer a rather unique habitat but they create problems. The group recommended that the Barrier Islands be reviewed with the objective of protecting the integrity of the islands and their lagoon system. We recommend that gravel removal activities on the islands be strictly prohibited. Access to the islands should be restricted during the period when waterfowl are nesting, molting, and staging. On State lands we recommend a period of June 15 through August 1.

We discussed towers along the coast and on the islands. They present a unique problem, especially since eiders are known to fly almost at high-wire level. Some cases have been reported of birds striking these towers or their guylines and some have died. We recommend that these towers be placed inland about 300 yards and that they not be placed on protrusions and points of land because the birds often cut across these areas.

We spent the entire morning talking about peregrine falcon areas. We decided that none of us really knew what we were talking about, so we passed the buck a little here. I think our recommendation is a good one that solves some problems. We kept in mind that 47 helicopters are expected to operate in PET-4 this summer. We recommend that activities be restricted adjacent to known falcon reproduction and nesting sites during the period of April 15 through August 15. Areas should be avoided by one mile horizontal distance where possible. Where this distance is not possible, a restrictive airspace zone of 1,500 feet above the bluffs should be imposed. You will note that this stipulation is just a bit more restrictive than the one currently imposed. Right now the distances are one mile horizontal and 1,500 feet over. The point was that if you can fly 1,500 feet above the cliffs, you should be able to fly 1,500 feet away, horizontally. We advise that aircraft avoid the area by one mile if possible.

We believe the areas concerned should be defined as conservatively as possible by the peregrine falcon recovery team. We're talking about protection of raptors--not solely of peregrines.

Specific stipulations should be developed to allow for recreational use of rivers or other areas adjacent to reproduction and nesting locations. Discharge of firearms should be prohibited, and areas for camping should be restricted. Such activities as photographing birds, hiking near bluffs or climbing them must be prohibited where the reproducing and nesting birds are located. We felt that a document explaining the Endangered Species Act, enforcement, penalties, and objectives, should be provided for the public.

Specific recommendations should be developed by the peregrine falcon recovery team, cooperating with the FAA, to direct the activity so that aircraft can be managed. Again, we recommend the flexibility to grant exceptions for activities on or in the vicinity of nesting locations. Exceptions should be granted, however, only after review by the agencies and the peregrine falcon recovery team. As an example, we have permitted on State lands activities in the vicinity of seabird cliffs where industry has convinced us that the nesting period is the time of year that is critical to their operations. The way we approach that is aircraft would land, I believe, three quarters of a mile from the cliffs, and loggers and rock handlers then proceed on foot, but not to the cliffs. They avoid the cliffs to prevent any disturbance. We have been able to live with that and so has industry.

We discussed caribou, and the group generally felt that the caribou do not appear to be overly sensitive to intrusion. Overt chasing or orientation of aircraft in the direction of the herd or a single animal do generate quite a bit of alarm. We recommend that activities be restricted in areas during the calving times. The area must truly reflect the presence of caribou. The Utukok River, for instance, is specified as a special area in the [Naval Petroleum Reserves Production] Act. I understand permits were issued last year and yet industry noted that the caribou weren't in the Utukok area, but were chomping at the bit to get onto the Driftwood airstrip. So, this calls for flexibility on behalf of the agency.

Regarding aircraft, we felt that enforcement of the State's harassment stipulation would likely achieve the desired results. Research activities should be permitted. They must be conducted, however, in a manner to reduce the stress on the animal to the greatest possible extent. The group was specifically concerned about low-level flights and repeated flights. They wanted to determine the percent of retention, etc., within the population.

We discussed musk oxen. I don't have experience working with them and I was surprised to learn that musk oxen are

extremely sensitive to disturbance. Dave Roseneau is doing some research for Arctic Gas. We recommended that he be contacted for specifics regarding the musk oxen situation. We did write a stipulation and we recommend wording as follows:

In order to fulfill the State law regarding harassment, musk oxen shall be avoided immediately upon surficial contact.

We felt that would be enforceable if an aircraft suddenly detoured from its route to observe the musk oxen. We also felt there should be a general stipulation regarding areas of non-habitation by musk oxen.

These areas should be avoided where possible and viewing with the aid of an aircraft or surface vehicle should be prohibited.

We also felt that to fulfill the State law regarding harassment of bears and Dall sheep, that area should be avoided as soon as the animal is seen. I think we can no longer afford the luxury of "show-me tours." When we see animals, we just look at that speck on the tundra and say, "Hey, there's a grizzly," and not move closer.

We definitely felt that a stipulation prohibiting feeding wildlife should be written. We also felt that the penalties for doing so must be imposed and enforced. The problem on the pipeline was that a person who was fired from one camp would show up the following day at another camp. I think we have a little better control of this within PET-4.

The group voted that recreational hunting and fishing should not be permitted by persons on official travel status. The rationale of the group was that close access would involve the use of helicopters, and hunting would be prohibited by State regulations.

MR. TILESTON: Does that apply to the Secretary of the Interior?

MR. GRUNDY: If he's on official travel status it does. I'm sure there will be some discussion later. This particular issue hurts me.

The second rationale was that good camp locations within PET-4 are limited and camps adjacent to water bodies could be large enough within the next couple of years to threaten overuse of the fishery resource.

The third rationale was that the stipulation is good public relations. If it were enforced, neither industry nor agencies could be blamed for a decline in fish and wildlife numbers, real or imagined, as a result of consumptive use.

We discussed carrying of firearms and agreed that firearms should not be banned. Most of us enjoy that security blanket. The Alaska Division of Aviation requires that firearms be carried in aircraft. We do suggest that use of rifles by persons other than supervisors should be discouraged. Fish and Game has encountered a similar situation. Stream guards working for the Protection Division of Commercial Fisheries were initially issued .30-'06 rifles and they killed several brown bears each year. When the transition from rifle to sawed-off shotguns came about, the numbers of bears killed declined sharply.

We also felt that the proper handling of putrescible waste would lessen its attraction to scavenging animals. Proper handling would reduce both this problem and the necessity for firearms.

A question was asked earlier about the stipulation prohibiting camps, especially seismic camps, on the surface of river ice or lakes. History of such camps is that they caused problems. Originally, it was stipulated that operators must camp on ice to lessen surface damage. Holes were punched in the lake ice and garbage was dumped in the lake. I think we have progressed enough so that we can trust industry more and monitor the camps to prevent environmental abuse of that kind.

Last fall, in discussion with the Fish and Wildlife Service, the problem of fuel spills arose. It was pointed out that fuel would be easier to contain and clean up on land surface than on lake surface.

MR. EARL AUSMAN (USGS): About that last statement you made, my experience on fuel spills has been just the opposite. It's much easier to do cleanup on a lake. You can move around the spill and when the ice flows off in the springtime, you can pick up the oil. But once you get it into the tundra, it's almost impossible to get out again. Generally, depending on the area you're in and so forth, the oil frequently ends up in the water, anyway. I think you're better off working with it on the ice where, in my experience, we've had good luck and were able to take it off the ice.

MR. SCOTT GRUNDY: Booming has been part of the thing. I can go either way on this.

MR. AUSMAN: Booming will absorb the materials to maximum capacity. Another fact is that a lot of the volatiles are lost, especially when the oil is out where the sun can get to it. The oil can't penetrate any deeper than the water so it stays on top of the water. If the sun gets to it over a period of time it helps.

MR. COPELAND: The present State policy is that no camps may be located on lake surfaces. The reason for that is a hangup from the past where camps had litter problems. Once the lake ice melted, it became difficult or impossible to clean up the surface. Before stringent control, 55-gallon oil drums littered the Arctic Slope. You can still fly over some lakes and see drums at the lake bottoms. They are very difficult to recover. If the litter problem could be monitored more closely and avoided, locating airstrips or camps on lakes could have little consequence.

MR. COAN: Canadian policy now recommends that people park on ice. I think the problem goes back to what Jules [Tileston] read about the 1913 standards for automobiles. Right now it appears to us that it would be more favorable to set camps on ice than on tundra.

MR. COPELAND: Another point I'd like to make is that the stipulation shouldn't specify either way. I think the decision should be up to the operating officers, depending upon the conditions. In one case we ran into early in the season, some of the seismic crews said they preferred not to park on the ice early in the season for fear that the equipment might sink through, and that's a very good reason. Several times, they skirted the lake with their equipment. So, I really think the stipulation should be kept flexible.

MR. PHIL JOHNSON: One point we didn't resolve was the disposal of the liquid waste, not the human waste, but the gray water, wash water, and that sort of thing. We hope some experts in the field of sanitary engineering and other areas can tell us how far-reaching an effect this would have. Perhaps it can be treated as effluent and dumped on the ice.

MR. OSCAR FERRIANS: I don't think that generally we are considering the principal land use of these areas when we come up with guidelines or stipulations. Some areas require different regulations from others, depending upon the principal land use. In a wildlife range you have certain restrictions in terms of the wildlife and fisheries, but in a petroleum reserve, I would think the restrictions would be somewhat different. To me, it seems as if all of the recommendations from the Fish and Wildlife

people are on the same level, whether we're talking about the Wildlife Range, PET-4, or the areas in between. I realize that there are some State and other regulations that would apply all the way across. But one thing that really hit me hard was the suggestion for an overall restriction on the level of flight of 500 feet. Over the coastal plains, this would effectively preclude any geological work from 500 feet or higher. We're constantly making observations from the air and landing frequently. I am not sure how this problem could be resolved or whether peregrine falcons are concerned, but I think that generally areas concerned can be outlined and people can stay away from them. That's easily done.

MR. SCOTT GRUNDY: Your point is very well taken. I think the approach should be based upon your needs. Of course, planning is the best way to avoid the problem. If that's not possible, then areas of restriction must be specifically described. In looking at waterfowl restrictions the group stated quite point blank that when the weather permits, aircraft should defer to an elevation of 2,000 feet. There's really no reason why they can't.

MR. FERRIANS: If the points are far enough apart, yes.

MR. GRUNDY: That's true. When you have gravity surveys or something like that, the request has to be looked at on that basis.

MR. FERRIANS: What about my other point in terms of principal land use of major areas? Shouldn't there be a little different approach, depending upon what the main land use is?

MR. GRUNDY: My personal reaction is to answer, "No." I think it should be pretty integrated, and I think we can apply it fairly uniformly across the area.

MR. FERRIANS: Then in the wilderness area you essentially have no disturbance but in a development area like Prudhoe Bay you have a lot of disturbance. So, restrictions would have to be different.

MR. GRUNDY: You obviously have to adjust your thinking from wilderness to Prudhoe Bay. The State is now taking a collective approach to try to minimize damage as much as possible during the exploration phase. Whatever "minimize" means, that's what we are trying to do. I think the word "manage" at the beginning of the workshop is the maximum term, and we're trying to manage all activities to generate the least impact practical. If you put the environmentalists on one side and industry on the other, the

two would proceed totally differently.

MR. FERRIANS: Where you contact in between is quite debatable.

MR. GRUNDY: That's right, and that's why it's so much fun. It's up to the agency really to bring these two extremes in and simply say, "Here's how we're going to solve this problem."

I might point out that as far as the subsurface values are concerned, the oil interests are primary and certainly should have top preference in any subsurface work. Top preference should be given to the geologists, engineers, etc., but the surface itself is a different matter.

MR. FERRIANS: But if the surface were protected beyond a degree, anything else would be precluded. This is not the point here. We have to be practical when there's an in-between area where we maximize protection of fish and wildlife but still permit ongoing research and work in the areas to get the main objective done.

DR. DAVE KLEIN: I think the Congressional mandate on PET-4 is pretty well laid out. I also think everyone has worked to achieve that objective, which is to minimize the impact as much as possible.

The State takes a totally different look. Once oil, gas, or mineral reserves are proven to exist in the area, permanent airstrips, roads, and other facilities are tolerated. Until that time, there's no reason why we can't keep the temporary status.

MR. LONNIE BROOKS: Scott, in the proposed stipulations you quoted relative to hunting, was fishing also prohibited? Was this general or something like the TAPS stipulation--within five miles. Or was it a blanket prohibition on hunting or fishing by anybody associated with any permitted activity up there? If so, why are you being so limiting in view of previous history?

MR. GRUNDY: The recommendation of the group was that both hunting and fishing activities should be prohibited in PET-4 by anyone who is up there on official business, on travel status. I was the only one who voted against the fishing aspects. Not even the National Parks people are allowed to kill fish. It was just felt by the group that overall, this boils down to good public relations--we'd be free from criticism.

MR. JERRY STROEBELE: I see a problem with prohibiting fishing because several parties of both the Alaska Department of Fish

and Game and the Fish and Wildlife Service will sample lakes in PET-4 this summer to determine the availability of fish. And the valid method of sampling is to use a rod and reel.

MR. COAN: The stipulation was written as "recreational fishing."

MR. STROEBELE: The point is: Should a fishing biologist be allowed to appear to be enjoying himself while he is fishing, while another fellow, who is looking into geology and archeology, is not allowed to fish?

MR. COPELAND: Then I would suggest that the geologist become a biologist if he likes to fish that much.

MR. STROEBELE: I think if we're looking at the public relations aspects there may be other considerations.

MR. SLOAN: We plan to do a hydrologic reconnaissance survey of lakes and streams in PET-4. We've done other recon studies on the Arctic Slope and we typically fish with rod and reel. We like to see what's in the fishes' stomachs. A biologist on our field team likes to know what they're eating, what they're getting from the bottom of the stream. Last year we were given collection permits by the State Fish and Game. When we outlined the plans this year they were broad in scope. We were told that we would not be given a collection permit which allows us to gather large numbers of fish but that we should take them under a sport fishing license. Here we're being told on one hand that this is what we should do, while you're proposing a stipulation that prohibits it.

MR. GRUNDY: I'm not speaking for Fish and Game on this. There will be a lot of problems with this stipulation. But we resolved what the committee opinion was by a show of hands. The recommendation for BLM is that this stipulation would be a part of their entry permit.

MR. KARL FRANCIS: I want to say that some of the thinking behind the question of fishing on government time involves the preferential access of people traveling in government helicopters. I think our concern was that those of us who questioned and, in fact, recommended that this kind of fishing be prohibited, focused on that question of access.

In the first place, biologists, and particularly icthyologists, have special knowledge of fisheries and if they are in fact using helicopters, they have another advantage. My personal thought is that if anybody here wants to go to the Arctic Slope

to go fishing, he should charter a plane like an ordinary citizen. I seriously question [that official people should fish], not just for public affairs reasons. An awful lot of people up there, particularly Native people, are very concerned about this special privilege of government and industry people and their access to the fisheries. I'd also like to point out that according to the people who have been doing research for us, especially with aquatic environments, these fish populations don't sustain the sport fishing very well. They are very sensitive, particularly the char population, and serious damage can be done by surprisingly little angling.

MR. AUSMAN: I'm speaking for myself as a private citizen. I've lived here for a number of years, and I've always felt that this question of preferential access probably ought to entail a lot more than just the Arctic Slope. I just couldn't pass up this opportunity to put in a word that I think that government and industry have a certain responsibility not to use their special privileges with regard to game and so forth. A classic example of this happened many years ago during the building of the Denali Highway. The contractor's people were hunting and fishing before the highway was open to the public at large. I am personally in favor of restricting any hunting or fishing on PET-4.

MR. GRUNDY: Any more testimony?

(FROM AUDIENCE): How about a vote?

MR. GRUNDY: Maybe we should do that. [Hunting] by people up there on contractual business--all those in favor--let's have a show of hands. What about the same restriction then for sport fishing--a show of hands!

I think there was more than half on both votes.

Fisheries

Questions for Group Consideration

What conditions are needed to protect arctic fisheries, with special attention to spawning/overwintering areas (e.g., water/gravel removal, water withdrawal, or changing snow regime so water or surface drainage freezes/thaws abnormally)? What is a reasonable distance for seismic operations from live water during winter (300 feet vs. 1/4 mile)? Summer operations? Restrictions on sport fishing?

REPORT: Alan H. Townsend, Chairman
BLM/Alaska Department of Fish and Game Biologist
Fort Wainwright, Alaska

I'll explain the composition of our group: One engineer, one hydrologist, and four fishery biologists. We were a little overloaded.

The group discussion came up with about 90 percent questions, 9 percent conclusions, and 1 percent recommendations. One of the main reasons for this was that the first question raised was: How can we, as a group, hope to formulate stipulations based on data that are not yet available? There is a large gap in the fisheries information on the Arctic Slope. The area where something is known is along the pipeline corridor, a narrow band considering the whole slope.

I'll read you a list of fisheries data needs that we discussed: Overwintering areas, spawning areas, gravel removal, water removal, stream crossings, blackening effects from dust, blowouts, etc., water quality, increased sport fishing pressure, general distribution of fishes, coastal area activity and its effects as well as effects of offshore activity, population reactions, commercial fisheries, subsistence fisheries. Other information we should have is the species composition and the age group composition. These are considerations that need to be looked at in the fisheries on the Arctic Slope.

We talked briefly on the technical area. The discussion went immediately to overwintering, then to gravel removal. One suggestion made was that deep-pit removal should be used instead of bar removal if only as an experimental method to determine whether fisheries overwintering habitat would be enhaneed or damaged by it.

Other gravel sources are oxbow lakes, whieh are isolated lakes. Some problems that we diseussed relating to oxbows were brine pockets and eonnective areas to the river channels.

We discussed general activities that affect fisheries. Water removal was the first one we discussed and we got right into permit requirements. We felt that the person applying for the permit should describe the rates and duration of their withdrawal, and the souree of their withdrawal, including the size, depth, and location. A depth requirement would be based on the surface area; in other words, a limit of 10 holes per 100 acres might be set--or depth and method of lowering the depth or volume of the lake might be regulated. The withdrawal period also should be known. It is much more critical if the water is removed in the winter than in the summer.

We would also ask the permittee to keep a record, either on a monthly or seasonal basis, of the deep lakes, lakes they have measured or have looked at as a water souree, and deep areas of rivers. The record would give the fisheries biologist something to go on during his review of overwintering areas, spawning areas, and any other physical characteristics that could be reported that would be of help. If the permittee keeps the record for the biologist, he has it for his own information and knows how mueh water he is getting or where he is getting it.

Alternate water sources were also discussed. These include snow and ice melters. Instead of applying for one water source, the operator could have two or three water sources. If the first one isn't acceptable, he would not have to go through the bureaueratic chain of communications to apply for the second one. The possibility of recycling water was brought up.

We also discussed gravel removal and other minings with implications for fisheries. For the gravel permit applications we would like to see these requirements: the souree identified, the quantities to be used identified; the method of getting this gravel, such as from a mining elaim; equipment to be used; fuel handling and storage; timing of the use; possibility of hydrological alteration of stream sources or of streams; mitigation measures; cleanup of the site after extraction; and method of handling overburden.

We came across an inconsistency in the literature during the short time we had to review the material. We found that limits for blasting distances from natural streams were cited as a half mile, a quarter mile, and 300 feet. From 300 feet to half a mile is quite a range. We were split about five or six ways on which distance was best or if any was sufficient. Information on surface protection wasn't available to most of our participants until the workshop had begun. This didn't give us adequate review time. We feel there is a gap in communications between the multiple agency approach to the field investigations and the handling of the permitting and stipulations.

One of our recommendations is that a cooperative group of representatives be developed from the various agencies to coordinate activities, and write stipulations for the long-time benefit of the Arctic Slope. This might be an ad hoc committee.

Another inconsistency we noted quickly concerned the fisheries. There are no restrictions on subsistence fisheries but a limit of 300 fish is set for collections within the Arctic Wildlife Range for any purposes. We don't know if the limit is for each year.

Some of the aircraft restrictions concerning wildlife may be causing logistical problems which cannot be avoided. On the Arctic Slope we know that aircraft restrictions may also become involved with weather restrictions. Two flight restrictions were given in the literature checklist: One was two miles horizontal and 200-foot minimum from special areas and the other was one mile and 1,500 feet. This would be rather difficult flying in Alaska. A couple of weeks ago when I was in the Petroleum Reserve, we had about a 300-foot ceiling over half the Reserve. I assume that it went up and down along the coastline.

Another recommendation our group would like to make is that industry requirements and stipulations for activities on the Arctic Slope should be uniformly applied for all groups, including government agencies and research groups. If industry has to live by them we should all have to live by the same permit systems and the program outlines, so that the permitting agencies know where and what is going on.

We definitely need an increase in fisheries research on the Arctic Slope, as there is almost a total lack of data available for judging and making stipulations. For this reason we did not formulate any stipulations. In our opinion, stipulations concerning fisheries for Arctic Slope activities should have an expansion sleeve in them. In other words, they should be made more stringent or relaxed as new information is received and

data found. Such information could include anadromous fish histories and removing blasting restrictions from lakes and streams if they are frozen to the bottom or water depths are too shallow. With this stipulation sleeve, information can be incorporated into workable plans.

MR. JERRY STROEBELE: The ceiling restrictions for aircraft on the Arctic National Wildlife Range are usually followed by the escape clause, "weather permitting," with no intention to compromise human safety.

MR. TOWNSEND: We looked at it more with the view that if you couldn't get up to the top of the ceiling, you stayed on the ground until you could.

MR. LONNIE BROOKS: What data were you using to evaluate the distance proposed to remain away from streams with blasting materials?

MR. TOWNSEND: Fortunately, we didn't. The recommendation for the half mile, quarter mile, or 300 feet is in the handout that we received yesterday. This is one of the inconsistencies that we found in the information that we received yesterday.

MR. STROEBELE: So you made no attempt to evaluate these different distances other than to observe that they were different in different stipulations, is that right?

MR. TOWNSEND: That is correct. I recommend that to keep away from the double standards, the quarter-mile restriction be used, such as has been used by Fish and Game in the past.

MR. STROEBELE: Why do you pick that one?

MR. TOWNSEND: Because that's the one that has most commonly been accepted and used in the past.

MR. GRUNDY: The quarter-mile restriction imposed by the Department of Fish and Game adjacent to anadromous fish streams has been in effect for many years. This was worked out in harmony with industry. Industry people were able to live with it rather well, until they got into PET-4. Exceptions have been granted for specific areas. One of the things that is really needed is a detailed analysis of the impacts. Probably the greatest concern in PET-4 is the effect of seismic detonations on whitefish fisheries. In fact, Al [Townsend] can tell you his graduate thesis concerned a related subject. I'll try to paraphrase this. He was studying at the time and thought hatching was temperature related. He set up a controlled labor-

atory situation where he had an aquarium which was moved across the room on rollers. Although the aquarium was moved slowly and carefully, the following day most of the eggs had hatched. This was in February. So what we can derive from the experiment is that movement possibly shocked the framework that stimulates the eggs to hatch. Therefore, what is the impact of a gentle nudge from a seismic explosion? These are things that we should look at.

MR. SANTORA: Could you determine whether it was a combination of physical shock opposed to temperature change or just the physical shock itself or is it the temperature and physical shock that induced hatching?

MR. GRUNDY: I would say that photo exposure (light exposure) to the eggs was minimum. It was a dark system with the lid open for probably an hour a day. The temperature was maintained from about the 15th of December when the eggs were collected, until the time of the hatching. It happened at less than 3°C.; there was no temperature difference.

MR. LONNIE BROOKS: What sort of control group did you have?

MR. TOWNSEND: I had to go back to the river to collect my eggs. I did not have another go at it at the lab.

MR. FERRIANS: I've done a lot of scientific research for many, many years but to me this doesn't seem like a valid criterion on which to draw a conclusion like this. It's really stretching in terms of seismic explorations in PET-4. There are so many water bodies. I can understand your concern and I can understand the significance of this, but from a scientific point of view, it would be mighty, mighty weak to draw all these conclusions from that one 20-minute test.

MR. TOWNSEND: I agree wholeheartedly. I would add that the eggs I had were incidental to the thesis.

MR. FERRIANS: I certainly would encourage research on this, because I think this is the direction we should go. We should really find out what the effects are so that we can come up with some reasonable stipulations or guidelines. But in the interim, I don't think we should go to the extreme in forcing conditions on the seismic crews just to counter this potential.

MR. TOWNSEND: Let me elaborate a little further on this before it snowballs away. I do not know when the fish eggs hatched. In fact, I contacted Lance Trasky of the Department of

Fish and Game here in Anchorage on an unrelated subject. The discussion got around to the whitefish eggs hatching, and he asked me if they had been moved. I said, "Yes," and he asked how, and I told him. He said that it was probably the shock. He had experienced the same thing when he shocked whitefish eggs before they hatched--a physical shock, not electric shock. Granted, research needs to be done on this. The question I pose is: If that type of a shock stimulates the hatching of these fish, then what does an earth tremor do since they are found in the Fairbanks area? Let me put it this way. I didn't have any way of recording on the Richter scale the jolt the eggs received.

DR. KLEIN: It seems to me everyone agrees there needs to be more research in this area. I don't detect any disagreement on that. Everyone says, "Well, we know we should do it." My question is: Who is going to do it? Whose responsibility is it to do the research? Is it the Fish and Game's, is it the BLM's, who comes up with the money? Maybe next year or the year after we'll be saying the same thing. We'll still be arguing how far from the stream we should allow blasting, and we still may not know the answer to this question. It seems to me this is something that should be determined this summer and a decision should be made soon as to whose responsibility it is to do it.

MR. TOWNSEND: I could add another question. Considering the overall blasting effects, what is a lethal blast for fish?

MR. GRUNDY: If I may expand a little bit on the credibility of Fish and Game, I indicated that this was pulled out of the air if I recall. I wasn't part of this group, it was several years before I actually arrived on the scene.

Several studies have been made in the vicinity of the shock from various types of explosives and quite a bit is known now. The State went through several years of hassle to define and put a ban on explosives in the Beaufort Sea. The Canadians have done a lot of excellent research on the effects of seismic explosions, and so has the Navy, I believe, in Chesapeake Bay, utilizing various species. There are a tremendous number of factors involved--the type of fish, etc., plus the actual amplitude for blast size. A blast using something like 300 pounds of charge for black powder generates a tremendous shock but it's slow burning. So that really has to be looked at. My personal philosophy is that it bothers me to see sportmen's hunting and fishing dollars being utilized in reaction to industry. I think that when an agency such as the Fish and Game has a concern like this and has some basis for needing this research, it's up to industry to fund the investigations.

MR. SANTORA: In your opinion does a seismic explosive charge as witnessed in the Reserve kill adult fish if it's 300 feet from the water bottom?

MR. TOWNSEND: I doubt that it would kill adult fish.

MR. FERRIANS: I have a comment. Some of these things are unknown, and obviously we don't have all the answers. But going in the other direction, isn't there a potential to permit a little kill? It might accidentally happen. We aren't trying to prohibit absolutely killing any fish or to prevent all damage. This is almost impossible. Wouldn't it be tolerable to allow for killing a few eggs?

MR. TOWNSEND: I agree that there is a line between absolutely no kill and total kill. The problem appears to be where to draw that line and how to get people to agree on that line.

MR. FERRIANS: The impression I get from the discussion is that they were talking about essentially no kill and we're guessing about the distance.

MR. TILESTON: I think we're wandering afield. We can beat this thing to death. The issue raised is somewhat like in the one on jurisdiction that Bill Moses raised this morning. We've got a definite area for research. I contend that the Geological Survey as of June 1, 1977, with its contract for responsibilities with Husky Oil Company has potential. I would contend that Fish and Wildlife through its research has capabilities on the 105(c) which likewise has the capability; I contend that industry itself has the capability. I know for a fact that Fish and Game was working with Navy two years ago to try to get an answer on this. The Department also was working with Husky and the Navy to try to get some answers this winter. They didn't get it quite worked out, but we all have the capability at this time, and I'm talking about financial capability. That's normally the thing that kills us. We have the financial capability if this really is a problem. If it's an urgent problem for which we need baseline data, we have the capability to do it. Now with that let's proceed to the next question.

MR. FERRIANS: I have one question I'd like to get into the record. Are there other sensitive areas that have been identified, say like fish hatcheries that can be affected by blasting?

MR. TOWNSEND: I'm not aware of any. But I would imagine that anything that could cause an additional load on the biochemical oxygen demand in an overwintering area could be a problem.

Air and Water Quality

Questions for Group Consideration

What is needed to insure air and water quality protection in areas where there is little, if any, present effect on human activity, that is, where base pollution levels reflect natural influences only? Are special restrictions to control waste products or fuel storage near lakes and streams necessary? Is there a significant change in water quality associated with wintertime water withdrawals? If so, under what conditions? Are the changes temporary or longterm?

REPORT: J. L. Brossia, Chairman
Environmental Field Officer
Alaska Department of Environmental Conservation
Fairbanks, Alaska

Basically what we've done is to review some of the stipulations and guidelines the State has used on the Arctic Slope in the last couple of years. We have a few general observations before we actually get into the air and water stipulations.

We felt there is a definite need for some type of enforcement stipulation to be written into contracts and other permits. This enforcement stipulation should have fine or permit-revoking processes included in it.

Second, the group decided that a preproject plan review process is needed. The plan review process should

start with basic proposal submittals. After review of the proposals, the plan would be either approved or denied. Only after approval would the construction project or the individual research project actually start. The project would be inspected on the ground, and then the various permits required would be issued. Some of you may have seen the agreement that was drawn up in the late 1960's by Joe Alter of the Alaska Department of Environmental Conservation. I have prepared an outline, presented as Table 1, for type of operation, population, duration of camps, and other considerations for solid waste disposal, water treatment, sewage treatment, and drinking water treatment in the Arctic.

We looked over Alter's guidelines and started the outline. The first type operation looked at was exploratory camps of one to two people who stayed up to seven days.

The solid waste plan for that type operation would be to burn whatever was burnable and to haul out what was not burnable. There would be no disposal in the field of any kind of solid waste.

The water supply, according to Alter, for a camp this size would be 5 to 10 gallons per day per person. The basic water treatment for a camp this size would be simply to chlorinate with chlorine bleach. We have guideline policy that we can enclose in any plan that comes in for this type operation, showing exactly how much chlorine bleach to put in the drinking water and so on. The chart distributed by the U. S. Environmental Protection Agency is shown on the following page. Treatment for sewage and waste water would be land disposal.

The next category we looked at was exploration camps of from three to five people, staying for about three days. The basic policy would be to burn the solid waste and haul out nonburnables. The water supply need would be 5 to 10 gallons per day per person, with chlorination as water treatment. The sewage disposal would be to bag and haul out feces and dispose of gray water and urine on land unless otherwise approved. In certain cases pit toilets may be approved.

Our next type of camp was a 20- to 30-man exploration camp, with a duration date of up to seven days in one spot. We felt that camps this size should incinerate all putrescible and other burnable garbage on site or haul it out. Water use increases to 20 to 50 gallons per person per day.

Safe Drinking Water in Emergencies

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION X

In case of failure of the city water supply system or your domestic well – other water may be available. Do not use water for drinking or cooking without the correct treatment recommended here. If in doubt, call your state, local, or district health office, or EPA.

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Community and city systems.

Before using fire trucks or other tank trucks for hauling water, call the District Health Office. Tank trucks must be approved before use. Severe sickness or death can result from contaminated water.

Use water from best sources.

Households can use water from the domestic hot water tank, or melt ice cubes while they are available.

Use this water only after treatment. Stock tanks, irrigation canals, streams, cisterns, farm ponds.

Use clean containers to treat and store.

Good containers are empty and washed root beer jugs, vinegar jugs or picnic jugs. The original labels should be removed from these containers and they should be relabeled "WATER".

DO NOT USE.

Soapy water. Septic tank trucks. Barrels which have stored chemicals, pesticides, caustics, gasoline, poisons. Severe sickness or death can result from contaminated water or containers.

Turbid water appears muddy or cloudy. Filter turbid water through clean cloths, or allow solids to settle. Use filtered water only after correct treatment or boiling.

Boiling is the most positive method by which water can be made bacterially safe to drink. Place clean utensil with water over high heat. Bring water to rapid boil. Continue boiling for 3 to 5 minutes. Use for cooking, or store in clean containers for drinking.

Chemical Treatments.

Iodine: Use to disinfect small quantities of water. Add USP tincture of iodine – iodine from medicine cabinet is suitable.

2 or 3 drops . . to . . . 1 quart clear water
8 to 10 drops . . to . . . 1 quart turbid water

Mix and let water stand for 30 minutes before using.

Hypochlorite solutions (PUREX, CLOROX, or other household bleach): Read the label for instructions to disinfect water; or find the percent of available chlorine on the label:

Available Chlorine	Clean Water	Cloudy Water
	Drops to be added per quart	
1 percent	10	20
4 to 6 percent*	2	4
7 to 10 percent	1	2
If not known	10	20

* Common household laundry bleach

Mix thoroughly by stirring or shaking water in container. Let stand for 30 minutes. A slight chlorine odor should be detectable in the water; if not, repeat the dosage and let stand for an additional 15 minutes before using. Water is safe to use.

HINTS and CAUTIONS

Commercially prepared tablets containing iodine or chlorine can be used for drinking water disinfection.

Water that is not very clear requires the dosages recommended for turbid waters.

If the treated water should have too strong a chlorine or iodine taste, it can be made more palatable by letting the water stand exposed to the air for a few hours, or by pouring it from one clean container to another several times.

In general, it is important to remember that ice made from contaminated water should be considered unsafe for use in water or other drinks. If the purity of the water is questionable, coffee and tea are safe only when made with water that has been boiled vigorously for at least three minutes. Water used for brushing the teeth or washing toothbrushes requires the same treatment as water for drinking.

Individuals who are restricted to a low sodium diet should be aware that water from water softeners has a high sodium content.

DISPLAY THIS CHART ON BULLETIN BOARD OR OTHER CONVENIENT PLACE.

GPO 999-272

Table 1. Solid waste disposal and water and sewage treatment for various sizes and types of camps on the Arctic Slope.

Type of operation	Population and duration	Solid waste	Water supply GPD/P	Water treatment	Waste Water	
					Black	Gray*
Expl. camps	1-2/1-7 days	Burn/ haul out	5-10	Cl2	Land† disposal	Land disposal
Expl. camps	3-5/2-3 days	Burn/ haul out	5-10	Cl2	Bag/ haul out	Land disposal
Expl. camps	20-30/3-7 days	Incinerate on-site or backhaul to approved site	20-50	Cl2 Filter	Incinerate or STP (Discharge see treatment)	Land disposal/ Filter
Dev. or larger base camps	50+/7 days	Incinerate or backhaul to approved site	75-100	Complete water treat. filters Cl2 contact	STP ‡ (See treatment)	STP ‡ (See treatment)

1. All camps may open burn wood and cardboard without an open burn permit.
2. No items may be open burned which emit black smoke without approval.
3. Designate entry points and central sewage disposal/solid waste sites.
4. Plan review all.
5. Landfill permit required, with stipulations; individual types of landfill stipulations enclosed under solid waste section.
6. STP operator certified by DEC.

* All discharges are prohibited from entering fish habitat or potential water supplies.

† a) Pit toilets minimum 100 feet from water bodies.
b) Two foot cover on abandoning site.

‡ No lagoon required provided that effluent meets State standards and does not enter water supplies or fish habitat.

In a camp this size it is recommended that a water treatment system with a chlorinator and filter capable of removing a 10 micron particle be used. Such a filter will prevent the spread of hydatid-cyst disease, which is caused by an organism known to be present in the Arctic.

For a 20-30-man camp, there are two choices for sewage treatment. They can either incinerate it in incinerator-type toilets or use a sewage treatment plant. Gray water could be land disposed but it would have to be chlorinated and filtered to remove organic matter to reduce chemical oxygen demand (COD) and biochemical oxygen demand (BOD).

The next camp was classified as a development camp or base camp operation of 50 people or more, staying for seven days or longer. They would have to incinerate or backhaul all solid wastes to an approved site. Water needs would be 75 to 100 gallons per day per person. Water treatment would have to have filtration, chlorination, and chlorine contact tanks. Sewage would have to be treated in either an incinerator-type system or in a full sewage-treatment plant, and standards have to meet secondary treatment standards as defined by the State. Gray water also would have to be treated to secondary standards through a sewage treatment plant.

All these camps would have the option of open burning cardboard and wood on the site. The basic rule is that nothing should be open burned that would create smoke problems. We also strongly urge that at designated entry points or logistical bases, central waste disposal sites be created. We would also consider placing large incinerators there so people could backhaul sewage and other waste to them.

Several incinerators are located around the periphery of PET-4. They are all owned by the Navy or private individuals. Two will be operated at Umiat this summer; the hotel and Geophysical Service, Inc. each have one. Camp Lonely has a good incinerator, and other incinerators and landfills will be located at Prudhoe Bay.

The Alaska Department of Environmental Conservation (ADEC) has an application for a landfill at Umiat. We can discuss that later with interested parties.

All camp operations should have plan review. The Department of Environmental Conservation also requires a solid waste management permit for anything that is buried,

except that seismic camps can dispose of incinerator ash down shotholes. On all other landfill permits, various stipulations for drill rigs, construction camps, pad extensions, and all sorts of situations that need different landfill arrangements are available and will be sent to individuals in the plan review.

Any discharge from a sewage treatment plant will have to meet secondary sewage treatment standards as defined by the Environmental Protection Agency (EPA). All sewage treatment plant operators soon will be certified by the ADEC.

If sewage treatment plants can comply with secondary treatment measures as the effluent leaves the plant, we are going to try to eliminate sewage lagoons in the Arctic. This will be done on a site-specific basis.

The reason we favor eliminating sewage effluent lagoons is simply that in many places you don't have to worry about water supply contamination or overwintering populations of fish. There are also areas where very little material is available for containment of this sewage.

Are there any questions on this section of our report?

MR. COAN: You're talking about the secondary treatment of these plants as defined by EPA. Does ADEC have anything different from what is done by EPA?

MR. BROSSIA: We do not.

MR. COAN: Are these stipulations made available when you issue the permit?

MR. BROSSIA: Yes.

(FROM AUDIENCE): I am a little concerned about the amount of water that these temporary units have per camp. I can't quite visualize how you would consume 100 gallons of water per day. These are pretty temporary installations. You know as well as I do that the problems multiply geometrically with the amount of water you consume.

MR. BROSSIA: The 100 gallons per day is for development camps or base camps where you have 50 people or more and you're in one location for a period greater than seven days, a construction camp like Lonely, for example. It's pretty well documented that water use on the Arctic Slope

is 70 to 100 gallons per day per man. It's a long-term situation. It's what they use, and it's also well documented that problems are created from dirty water discharges and lack of water.

(SAME VOICE): It's pretty well documented also that people who lived up there for hundreds and thousands of years survived on only one or two gallons a day.

MR. BROSSIA: That's right. This is also evidenced in these small tent-exploratory camps that only use 5 or 10 gallons per person per day.

(SAME VOICE): Which is a lot!

MR. BROSSIA: Right, but you have to consider the types of things that go into the use of 100 gallons of water a day. For example, a conventional flush toilet uses probably 5 gallons of water every time it flushes. How many people walk in and leave the faucet running while they wash their hands? How many gallons does it take to take a shower and so on? So you see that adds up very quickly.

(SAME VOICE): Flush toilets over solid permafrost!

MR. BROSSIA: Except for some incinerator type toilets, camps are using flush-type toilets.

(SAME VOICE): I recognize that, and the residents of the country are feeling that some of the agencies are practically forcing this on them and they can't afford it. This is leading to disaster in the Arctic.

MR. BROSSIA: The values given for water use are not recommended values; they are just best estimates of how much water actually is being used.

MR. LONNIE BROOKS: I have several questions. One is: Are your water supply requirements consistent with those of the Department of Occupational and Safety Health of Alaska?

MR. BROSSIA: I have to plead ignorance on that. Basically, I believe the OSHA standards state that "water shall be potable" and the definition of potability is "free from bacteria." They usually kick everything over to us. I don't know anything more about their standards than that.

MR. BROOKS: Why is chlorination specified as the approved water treatment method when other methods are

available?

MR. BROSSIA: It's basically used for exploratory purposes. It's easy to carry a bottle of Chlorex.

MR. BROOKS: Iodine is pretty easy, too.

MR. BROSSIA: We don't have any problem with the use of iodine.

MR. BROOKS: Is disposal of incinerator ash down shotholes to be approved onshore only, or will that also be for offshore, and if not, why not offshore?

MR. BROSSIA: Basically because of problems we've had in the past when we said incinerator ash only. People tended to stretch it a bit. Other things going down the shothole with incinerator ash was what gave us a problem. That's about the only answer I can give you.

MR. BROOKS: Is that a guideline or is it a rule?

MR. BROSSIA: I think the whole idea behind this is: (1) We need enforcement check to see what they are actually doing in the field; (2) We need to approve the plan on an individual basis. I'd be the first to admit that I'd hate to see anyone locked in with concrete stipulations. As I said earlier, this is a guideline, it is something to start with. This is where we started and at least it is available for industry or for State and Federal agencies to know that we've looked at the problems to get an idea of what to tell them in the field.

MR. JOHNSON: I believe from your preamble that this is oriented strictly at industry and at governmental and research operations.

MR. BROSSIA: That is correct. We felt that for recreational use by one or two people, the regulations would be the same as for an exploratory camp. But they are lenient enough so that the regulations shouldn't be a problem.

MR. JOHNSON: Do you feel that somebody should log hikers, for example, in the area?

MR. BROSSIA: I personally do not, but that depends strictly on the number of hikers. If they become a problem, I'm sure we could control it. I know the Department

of Fish and Game has been highly concerned over the moose hunting camps along the Colville River. We have had problems on the Colville with solid waste.

MS. GROPP: You were talking about central entry points for waste disposal sites. I think that's a very good idea. Who would provide it and who would run it?

MR. BROSSIA: This is a touchy question; that's the holdup right now on establishing a landfill at Umiat. We think we might have a couple of areas where we can put the landfill in, but we are worried about putting it in without having a full-time operator to manage the landfill in a manner that is acceptable to the Department.

The basic premise behind putting landfills in is that they would be regional facilities where anyone passing through the area could use them. There aren't many people who are willing to clean up someone else's garbage. You also get into legal problems. If you have 10 or more customers, you need a public utility commission permit, but if you have fewer than 10 customers, you can still charge and you don't need the permit. There are other legal problems as well.

(FROM AUDIENCE): Regarding those guidelines, whether you discard the sewage on the land or haul it out, I think there's an inconsistency in those first two categories you mentioned. If you calculate man days, you've got overlapping. Some gray areas are there.

MR. BROSSIA: You're definitely right; that needs more study. In fact, once we really get rolling and look at their guidelines, maybe we can establish another class for somewhere between 5 and 20 people. To summarize the chart, I'd like to say that you should submit a proposal. We can review it and start from there.

MR. JOHN SANTORA: What you're essentially saying is that the guidelines that are presently proposed are subject to change when we have some valid information that shows a change is warranted. That's a beginning point. They're not hard to understand. We're not tying anybody down, we're not that tough. We've got to start somewhere, and that's the beginning, right?

MR. BROSSIA: That's exactly right! Thank you. Now to move on, in cooperation with several of the other agencies, Fish and Game and the State Division of Lands, we

have come up with some basic guidelines and policies that we have followed on the water use policy on the Arctic Slope. I am going to run through some of these; a lot of them will be open to debate. They are not hard-and-fast, but I feel they should be at least listed for the record.

1. The basic policy our work group agreed upon is that no water should be withdrawn from streams or lakes with overwintering fish populations for other than domestic purposes, unless otherwise authorized.

2. Snow melters, desalinators, and ice crushers are to be used for water supply in areas of overwintering fish populations when possible.

3. Salt water, brackish water from shallow lakes, treated sewage effluent, gray water, snow, ice, and waters from lakes that do not contain fish shall be used for mud makeup, drilling purposes, and industrial uses, unless otherwise approved.

4. In areas of limited water availability, reservoirs are to be used when necessary. Reservoirs shall be filled during peak stream flows or when adequate water is available.

5. Water-saving drilling programs shall be used and the best state of the art technology utilized in areas of water shortages, unless otherwise approved.

MR. COAN: I like your approach of giving latitude to the approving office to work with the permittee to work out the problem and solve it out in the field. I think this is good judgment. When you talked about getting with other agencies, however, you didn't mention Federal agencies. As a Federal bureaucrat, I like to eliminate double standards. I think it will be a good idea to get the Feds involved as well as the State agency when you go to this sort of thing.

MR. BROSSIA: Right. The reason I mentioned that we came up with State policy on this was the simple fact that the Department of Natural Resources issues various types of land-use permits on the Arctic Slope and the Department of Environmental Conservation and Fish and Game comment on these permits, with most of the work done on State lands.

MR. COAN: It would be nice if the State and the Feds operated the same way.

MR. BROSSIA: You're right. The next category that we included in this air-water workshop was a brief listing of stipulations on hazardous materials.

1. Basically, we decided that hazardous waste material disposal sites shall be selected, although none may be established on the Arctic Slope. They might have to be in Fairbanks or south of the Yukon where we don't have permafrost areas. In light of what Jules [Tileston] and Don Keyes said the other day, this general statement might be thrown out, but it is a point we wanted to make.

2. Downhole reinjection of waste oil and cleanup fluids or other means of disposal will be approved on a case-by-case basis until adequate disposal sites are utilized or approved. Many of the oil companies have the capability of reinjecting waste oil, cleanup material, or those types of fluids into other formations. I realize there are some legal problems you get into with Division of Oil and Gas rules. Here again, the matter is open for discussion.

3. Surface oiling with waste oil, calcium chloride, or other fluids must be approved on a site-specific basis.

Those are the only statements we had on hazardous materials. Again, the main reason we listed hazardous materials was to control pollution runoffs in the waterways and water problems.

MR. SCOTT GRUNDY: Have you looked at the possibility of having the companies inject waste petroleum products back into the pipeline?

MR. BROSSIA: Yes, we have. We are close to coming up with a solution for waste oil disposal along the corridor. It's being reinjected at a site along the trans-Alaska oil pipeline. The Energy Company of America for Alaska also is considering a waste reinjection site. But that answers only a small part of the problem and the question is: What do you do with hazardous material in the field? In Prudhoe Bay they are planning to use a reinjection system for waste oil. It's not complete, but at least we are moving in that direction.

MR. COAN: I assume you're talking deepholes, not 100- or 150-foot holes?

MR. BROSSIA: That's correct.

The next subject we addressed was drill muds.

1. There shall be no discharge of drill muds or fluids to freshwater lakes, streams, or other drainages.

2. There shall be no discharges of drill muds to the uplands unless such discharges are approved.

3. All mud or reserve pits shall be contained in a manner that prevents leaching.

4. The use of products in the drill mud that have high BOD or COD are prohibited unless approved.

5. Drill mud program components shall be approved on an individual basis. A competent review staff is needed to review the products used in the mud program.

6. A minimum shall be established for the distances between mud pits and sensitive aquatic systems on an individual basis. We didn't have a good rule of thumb to start with--whether it should be 100 feet or 1,000 feet. Here again, it's more or less a point that was made rather than a hard and fast stipulation.

7. All chemicals used in the drilling program must be stored on pallets off the work pad to prevent weathering, spillage, leakage, and other loss of these chemicals. Disposal of toxic products will be on an approved basis.

My intention and that of the group is that we would like to see a little research done on planned disposal of drill muds if this is approved. In about 14 cases, wells have been drilled (most of them shallow) in the South Barrow gas field, without mud pits. An immediate problem was created, but the long-term effect is what we need to consider.

<u>MR. EARL AUSTIN (USGS)</u>: Have you considered what you might do if someone has a problem with a well and has to bring in exotic chemicals or something of that type on a rush basis?

<u>MR. BROSSIA</u>: I think anything that pertains to safety or in an emergency situation, we would have no problem with whatever it took for containment.

Our next general topic of discussion was air. As Larry Dietrick indicated on Wednesday, one of our major

concerns is Prudhoe Bay flow testing wells. Millions of gallons of crude oil have been flared and literally hundreds of millions of cubic feet of natural gas. At present, many energy efficiency reports are being done within Alaska and in the Lower 48. We are concerned about wasting hydrocarbons. We are not interested in eliminating one problem and causing another. By that I mean we are not encouraging that more energy be utilized to stop a flow test than is lost in the flow test. I think what we are really interested in is looking at some means other than just flaring a million gallons of crude oil. Now we will go on with some stipulations.

1. Flow testing and well cleanup shall be minimized, and each test must be approved on an individual basis. The reason I make this statement is that originally, when ARCO and BP wanted to do their testing in Prudhoe Bay, they had 180 wells. Now there are probably going to be more than 400 wells. They wanted to test the majority of them and flow test the whole field. They ended up flaring several hundred million gallons of crude oil. Now at least we're reducing a small percentage of flow tests and encouraging reinjection of crude oil into the pipeline. We can look at alternatives. We don't want to lock anybody into a hard and fast way of doing something, but we would like to push the idea of exploring alternatives.

2. Alternative means of flaring oil wells shall be utilized in critical areas. In such cases, fluids shall be containerized or disposed of in an approved manner.

3. Approval must be obtained before spilled hydrocarbons are burned. Open burning of spilled oil will be considered only as an alternative measure. All spilled fuels shall be vacuumed up or reclaimed to the maximum extent possible.

4. No well cleanup fluids such as acids, caustics, or other toxic materials shall be open burned without approval.

5. Crude oil products and cleanup fluids shall be injected into existing pipelines or storage facilities if these facilities are available.

6. Smokeless burner devices, air curtains, and alternate technology for flow tests with flared fuels, shall be employed to the maximum extent possible to maximize combustion of flared hydrocarbons.

Several general statements have been made that more research and development need to be employed. As an off-the-wall comment, I suggest that problems such as polymerization of flowed hydrocarbons needs to be explored. Again, more technology needs to be studied.

Another subject to be addressed is oil spills and approval for contingency plans.

1. SPCC plans must be submitted when 660 gallons of hydrocarbons are stored aboveground in a single tank or when 1,320 gallons of fuel are stored in an aggregate of tanks aboveground, or when 42,000 gallons of fuel are stored belowground. That is basically the requirement that EPA has set forth for submitting SPCC plans.

2. Plans must be submitted by a registered Alaska professional engineer.

When an SPCC plan is reviewed these guidelines should be considered. The items listed have been the causes of many major spills on the pipeline on the Arctic Slope.

3. All camp fuel lines shall have welded joints rather than threaded joints. Fuel lines are further to have an expansion or flex couplers every 100 feet.

4. All fuel storage facilities managers are required to keep accurate use records so that fuel quantities on site are readily determinable.

5. All fuel storage areas shall have a metering system and volume gauges.

6. All fuel storage tanks shall have pressure relief systems.

7. Each individual fuel storage tank shall have an individual pressure-relief system. Manifolding of pressure relief systems is prohibited.

8. Manifolding of fuel storage tanks together is prohibited unless approved on an individual system.

9. All fueling facilities shall have an attendant on duty who is familiar with the shutdown system of the facility when the fuel is dispensed.

10. An oil spill cleanup crew shall be in all camps.

This crew shall be trained in the use of oil spill cleanup materials and know proper procedures for reporting spills.

11. All fuel truck drivers shall be thoroughly experienced in cleanup, notification processes, and have demonstrated experience and knowledge with the vehicle to be operated.

12. Aboveground fuel lines shall be built in utilidors, with special protection at vehicle crossings.

13. Bladder tanks shall not be used unless approved on an individual basis.

14. All hydrotesting of pipelines, fuel lines, shall have an SPCC plan submitted by an Alaska professional engineer.

MR. BROOKS: Did I understand correctly that all fueling facilities have to have a metering system and volume gauges?

MR. BROSSIA: That is correct.

MR. TILESTON: I've talked with EPA on some of this and my understanding is that some of these tanks are here for permanent storage. How do we handle and how do you use this? In other words I can see that where you've got a drill rig on a construction camp the stipulations fit the situation. Or if you've got a seismic camp, it's a complete self-contained operation. How do these compare to camps of one or two people who are operating out of drums that are sitting on the tundra, or base camps which are there for 30 days? They may have 50, 60, or 100 drums of fuel sitting there, that then disappear.

MR. JOHN SANTORA: Is a gallon of fuel spilled from a temporary installation any different from one spilled from a permanent installation, once it's on the ground?

MR. BROSSIA: That's a good answer! What I would say is that it depends strictly on the amount of fuel. Here again, I consider these to be guidelines rather than laws.

MR. JOHNSON: In our technical group here yesterday, we got extremely interested in the idea of establishing winter camps on lakes and streams, rather than on the uplands. I thought you should be aware of that.

MR. CARL OGDEN: I have a comment to make with regard to welded fuel lines. I think the welded fuel line is preferable. But I think you have to be very careful in putting these things together that you don't restrict people to bringing up another craft, for example a welder, to put in a five-foot piece of pipe or something like that.

MR. BROSSIA: Your point is well taken. John Santora pointed out this morning, when someone wants to put in a camp, you can't lock him in with these stipulations. As I said earlier, these are merely guidelines that should be considered in the SPCC plans.

MR. GAL: What about guidelines covering the use of insecticides or pesticides?

MR. BROSSIA: We would handle those with State regulations that are being formulated now. We haven't had a problem per se with pesticides on the Arctic Slope, except for a couple of isolated examples where we had stored DDT. That was at Umiat and we didn't really have too much of a problem. We handle them as hazardous materials.

MR. BROSSIA: I'd like to say one last thing about the oil spill guidelines. We've had about 10,000 oil spills in the last 14 months on the pipeline. In that period every one of these guidelines was incorporated in the major spills. Four camps north of the Yukon have had direct fuel line failures because they did not have welded joints. We've had one major spill of almost 100,000 gallons because they did not have a pressure relief system. We had a near-disaster and could have lost over a million gallons because the tanks were manifolded together. So these are not idle comments. They are based on actual field failures of fuel systems. The chief cause of most of the minor spills--up to 5,000 gallons--has been strictly inexperienced fuel drivers on tanker trucks. I realize the problem you get into with dealing with the Teamsters' Union and so on, but most of the people involved in fuel truck accidents were inexperienced. This problem really needs to be addressed.

We would like to make a few recommendations before leaving, and these could be written into stipulations.

1. Snow roads, ice roads, and ice structures should be used in place of permanent facilities when possible.

2. Land disposal of drill muds and sewage should be

investigated.

3. Feasibility of removing pads, airstrips, roads, and other facilities after project completion should be considered.

4. Feasibility of using jack-ups, wood piles, wood cribs, and other types of rig platforms should be considered.

5. Research should be conducted to determine if thickness of camp pads, roads, airstrips, and other workpads could be reduced by use of rigid styrofoam or other insulation.

Finally, I want to discourage industry from overreacting to statements made by regulatory people. I would like to perpetuate the idea that good engineering design is good for the environment and try to discourage wanton waste of money strictly to appease the environmentalists.

Technical Considerations

Questions for Group Consideration

How much snow, where, for what purpose? What is a practical tred pressure for summer? Winter? Should there be concern about turning radius? Can equipment be airlifted to site and will airlifted equipment do what is needed? Air-cushion vehicles? Bechtel or Houston Rolligons, where and why? Do snow machines cause problems in winter? Summer? Should exploratory drill pads and airstrips be removed? If so, when, how, and where should material be placed? What type of revegetation is desirable for disturbed sites? Are there means for stabilization of disturbed sites other than revegetation? When should nonvegetative stabilization be used?

REPORT: James Coan, Chairman

We had one thought first and that was stipulations. They bothered nearly everyone in our group. As you all know, I had some part in setting up this symposium workshop, the title and so forth. I am going to recommend for the record that the title be changed to "Surface Management Guidelines." Stipulations, in the sense that they mean rules, operating procedures, what you can and cannot do, were not the objective of this symposium. I was looking at guide stipulations, a whole set, so that any land manager could take this set of guide stipulations, cross out the inapplicable ones, and come up with a uniform set of stipulations that he can use throughout his management area.

One general comment I have is that the guidelines have got to have latitude for operation, coordination, cooperation, and working relationships between the permittee and the enforcement agency. Nearly everyone who has spoken today has emphasized this.

Our group reviewed Fish and Wildlife permit stipulations that were given to Alaska Arctic Gas in 1972 for exploration work on the Arctic National Wildlife Range. We also went through the Navy seismic stipulations and tried to relate them to the real world. The stipulations were designed to cover a special function and also all types of activities, including recreation and seismic, by anybody who's going to be out there and do anything on the land.

I'll begin with solid waste disposal sites. This was discussed by DEC today. As I understand it they are going to try to establish some sites. We feel this is a strong need. It's not economical to load solid waste up and ship it to Fairbanks, where waste disposal conditions are already crowded or ship it to Anchorage, or put it on a barge and ship it to Seattle. In other words, we need to get rid of this transfer problem on the Arctic Slope. Solid waste disposal sites are a primary problem for any operation on the Arctic Slope.

We consider the flight restrictions to be completely unreasonable. Two thousand feet is too much. The speaker before me said that he'd like to fly that way but the weather is usually 300-foot ceiling. That's been my experience, too. For point-to-point flying 2,000 feet is fine but when you're going to do any work, as you've heard Oscar [Ferrians] say, you have to fly at 50 feet. I would say others feel the same way.

We had a problem on the 300-foot blasting distance. Someone in the group suggested going 300 feet and reducing the charge size or going 100 feet and going down to still a smaller size charge. Why relate it to feet? Why not relate it to what you're going to do?

Phil Johnson, with CRREL, brought up some information. I'd like to ask him to say something about it before I move on to our next topic.

<u>MR. PHIL JOHNSON</u>: Scott Grundy mentioned that a certain amount of information is known about pressure, but I'm not exactly sure of the type of data he may be referring

to. I can state that CRREL has been involved for the last two years, in cooperation, I think, with Du Pont Laboratories, in studying the pressure patterns that emanate from permafrost. This work was done on Fort Wainwright property. I will pursue this further, find out what I can on the subject, and make the information available to whoever wants it, perhaps through Jim. [Report of the research referred to by Mr. Johnson is printed as Appendix B of these proceedings.]

MR. COAN: Okay, let's get on to the oil spills. EPA guidelines set up a good reporting procedure and fuel handling procedures which have to be modified according to site conditions. Our group came up with a contingency plan for a two-man outfit. This contingency plan would be somewhat different from the TAPS project contingency plan, but it has to be relative to what you are doing, how you're handling your fuel, and where you are handling it.

One comment on these stipulations was that for seismic operations, lines are not shotlines--they are seismic lines. The stipulations lead one to believe they apply just to the shotline. A shotline is just a little piece of wire attached to a detonating charge. We want to have surface management on the seismic line.

Although some of the group agreed and some disagreed, I think it's vitally important to recognize that the only mechanism we have of getting the work out of the guy in the field is to tell him what we expect in the way of surface management.

We also discussed costs. I understand that industry doesn't feel they should bear the brunt of putting their people in. It costs them $30/hour to set up. They've got 100 people and so it costs them $3,000 for us on the Federal side to give them an environmental briefing. I feel that if we could put together a program for industry, they would gladly present it to their people when they hire them. The only thing we would have to be assured of is that through the environmental briefing, the guys in the field would know and understand what we are going to enforce.

I think I've covered everything except summertime operations. Summer seismic operations developed into two items: one--helicopter travel, or two--surface travel as approved by the regulating agency. I have a few reservations on the latter; but because of the way the state of

the art is developing and advancing, I see no reason to stop anybody from requesting or proposing summertime operations using surface travel procedures, providing they comply with our guidelines.

Finally, everyone attending the symposium was handed 30 to 50 pounds of data when they came into the room. If you have time to go through it, you'll see where the double standards are and what we are trying to eliminate.

I personally feel that with good surface management guidelines, if everybody starts from ground-zero, we'll be able to eliminate a lot of double and triple standards. Everyone will comply with the same rules, regulations, stipulations, or whatever you need to make the enforcement feasible. It won't require a great big army of people to send out to enforce what we feel is necessary for protection of the environment.

MR. PHIL JOHNSON: Jim, I think our group ought to go on record on this winter camp on ice.

MR. COAN: Oh, yes. The winter camp was discussed. The Canadians actually recommended camping on ice. I've got a copy of their stipulations. I didn't get them printed for you because I didn't know if they were copyrighted. They recommend camping on ice. They feel they can control environmental damage better if camps are placed on ice than if they are on the tundra. I see a lot of benefits.

I don't think we are in a situation today where seismic people, industry people, and others who work in the Arctic are not going to clean up their rubbish. They are going to handle their solid waste in an approved manner. I think the problems of industry not doing it are so great, that they are doing it automatically. I still think we need to be there, but basically they are geared to do just what we are requiring them to do.

MR. SANTORA: Eb Rice said it well when he told about that fellow who was hanging over the cliff. The Lord said, "I'll help you but you've got to let go of the branch." He wanted to know if somebody else might be up there who could help him instead. Everything you say is true. I think we can camp on the ice if it's done in an appropriate manner. I'll also say that I'm going to have to see a great improvement in fuel handling before I accept that it will be done in a clean, workmanlike fashion, with true

concern among all involved as to what is taking place on the ice.

MR. COAN: We have to be there, do we not?

DR. KLEIN: There still would be a couple more questions about camping on ice which will have to be resolved. These were brought up earlier and relate very much to fisheries. Alan Townsend pointed out that one of the most critical factors affecting overwintering populations of fish or eggs is a limited oxygen supply. If any materials are going into the lake which are going to create an increase of oxygen demand through degradation, it is going to have an effect on overwintering fish. I think we have to know what the effect on fish is of, say waste water going into the water systems under the ice. This is not just an overwintering problem, but continues when breakup comes and these waters go into the system. As I understand it now most of the seismic camps that operate on a lake-type situation are not prepared to pump the waste water onto the land surface. They would have to dispose of it by discharging it right onto the lake ice. Perhaps more critical than lake ice is river systems, where you have very limited pockets of water with overwintering populations of fish. Usually, spawning gravels are associated with this.

I think those questions have to be answered before you can just arbitrarily say that the ice is a better site for a camp. Perhaps it can be dealt with by having the authorizing officer look at specific instances for threats to the fisheries and avoid them.

MR. JOHNSON: I'd like to point out that, as we all know, a lot of shallow lakes freeze to the bottom. Apparently all of these rivers, including the Colville, freeze to the bottom. I think there would be camping in these areas but I see very limited problems here. I agree with prohibiting camping on the live lakes and over the pools of water on the Sag River. A lot of these places have been hard to find.

DR. KLEIN: If you don't know where they are, how can you arbitrarily say, "Okay, I'll go ahead and camp on the river ice?"

MR. JOHNSON: You have a good point there, although I'd like to make a point, too. Statistical probabilities of camping there are quite poor; also, there might very

well be terrain clues to show what is there.

MR. COAN: One thing that made our group interesting was that both of these gentlemen talked in our group.

MR. JOHNSON: Frequently when you're on rivers you don't need to camp on the ice because you've got a bar or something else. If you spill oil, of course, it goes down into the gravel and nobody enjoys getting it up. It is even worse if it goes on the ice, but you can camp on bars in the river. The policy generally in our area is to camp on lakes and other waters that freeze to the bottom. I suppose there are times when you would want to camp on a lake that doesn't freeze to the bottom over the years. It might be all right if the situation were favorable and the best alternative.

I think the potential conflict is that frequently, but not always, you go in and try to locate a campsite where water is available. It may be the very water the fish depend upon for overwintering.

MR. COAN: I'd like not to resolve this difference of opinion now, but I would like to say that I agree with Dave, I agree with John, and I agree with Phil. What it boils down to is that we need to do some studying. I just don't see it any other way.

MR. CHUCK EVANS: I'd like to reinforce what you say. We've heard a lot of things about the studies that are required and I guess what I am going to do is just repeat what some other people have said. I am concerned about the use of the expression "guidelines." We've lived with this guideline business for quite a long time. It's turned out that the guidelines don't do much. I realize you're recognizing the necessity of having them, Jim, but by the same token I agreed with your statement that you have to be there. I also think that even though you must develop rapport with the people you are dealing with, my experience has been that stipulations and regulations provide a better working mechanism than do guidelines. I recognize that the regulations and stipulations must be enforced, there's no question about it. I wouldn't disagree with any of it. But I think you have to have something to fall back on that has the strength of regulations, that's all there is to it.

MR. COAN: I didn't mean to lead you down the path. For this symposium I use the term surface management guidelines. I think we're going to come up at the end of this

session with 200 to 300 stipulations, if you want to use that word. I want to use the word, "guidelines." Anyway, we'll come up with 200 to 300 different items. These are guidelines to start to prepare your stipulations that are attendant to any permit that is granted. The enforcement--notice to proceed and so forth-- will be the general part of the stipulation. The general part of the permit stipulations that are attached to any operation would be enforced by notice to proceed or whatever other mechanism you might set up. That's why we have recommended guidelines--to give us a basis to start to develop the permit stipulations. We'll all start with the same point that way. If Chuck and I were to sit down right now and start writing a set of stipulations, I'm sure they would be considerably different. If we start from the same point, at least we've got a chance of operating under the same standards, not double standards.

MR. EVANS: I certainly agree with you on this double standard business, and I know we've lived a long time with this charade of surface operating "guidelines." Everybody called them regulations and stipulations and so forth--but their existence was all that was required. Nobody was required to solve anything. I'm trying to say that it really didn't help the situation very much. I do appreciate your clarification but I am a little concerned about going too far this "guideline" way.

We've been asked today to look at ways to minimize the distance between shotholes and bodies of water that support fish. We've tried for years and years and years to get industry to help provide the sort of information that would be required to make such adjustments and thereby cut their costs, but they insisted that it couldn't be done. We were told year after year that you couldn't conduct these seismic surveys over the water in summer or over ice without firing shots. These various procedures just wouldn't work. After a while it turned out techniques could be developed. I think such requirements must be in the system. I just want to make this point. I don't think we can compromise the biotic resources of that area indefinitely. We know from the very moment the decision is made to "go" (to explore for hydrocarbons) on that area, that we'll have to live with some compromise.

People are living in that area who depend on these resources; the resources have value to the entire United States. I think the compromise has to be done with a great deal of judgment, a great deal of conservatism, even though

it does increase the cost a little bit. We all know that. I think in the absence of precise knowledge there just is no alternative. The job is to minimize disturbance.

MR. COAN: And that's why we recommended we get the precise knowledge first.

MR. JACKIE HUDSON: I would like to take a little exception to the fact you indicated we did not go along with the experiment. I know we did try to get together with several agencies a few years ago to do this experiment. We would like the program and would like certain guidelines attached to the experiment.

MR. COPELAND: One important physical factor I'd like to point out that should be in the record is that we're experiencing in the Prudhoe Bay development area considerable activity on the surface of the rivers. This may also apply to some lakes that may not freeze to the bottom or might get fish in them. The river system is the only area in Prudhoe Bay where we do have fish. The fact that the surface of the lake or river where fish are overwintering is disturbed probably causes an even greater impact than contaminates introduced in that water because disturbance causes greater freezing of the water and therefore makes less water available. Where snow is cleared from the surface over ripples or pockets where overwintering fish live, compaction of snow or removal of the snow could prevent passage and kill the fish.

MR. COAN: Good point!

MR. TOWNSEND: I'd like to make an observation here. If the agencies and scientific community were to introduce their left hand to the right hand to the extent that industry has and know what each other is doing, I think we might take a step toward progress and results in the fisheries.

MR. COAN: I'll buy that. John Santora's group has a quarterly meeting where government agencies, private industry, private sector, Natives, and everybody concerned with PET-4 comes together. In the BLM state office, this is our second symposium in which the goal has been to bring everybody together and work together. We hope to get the system down to a fine point!

Summary

Jules V. Tileston

As the second annual BLM symposium of surface protection closes, I want to make special recognition of people who are here on their own time or their companies' time, because their participation has been the key. Positive areas for change have been identified. We've got unsolved issues. Some of these deal with baseline data, some with jurisdiction, but I think it does us good to at least break out some of those issues.

There is a key point which I believe is fundamental. If we leave here with nothing else, as Jerry Brossia said this morning, we should recognize the need to avoid knee-jerk reactions. They bring us nothing and frequently cost us heavily in the long run in terms of everything--time, money, and the environment.

One message, carried by almost every speaker, came through loud and clear in the discussions this morning. That is--we must work together. We need to know each other's priorities and realize that these priorities are different by law, by regulation, or by need, because we have different perspectives. By working together, we can still get the job done in the right way.

Terminology is a bugaboo and always will be, but again, we can work together and learn that shotline is not a piece of string or a line on the ground. As long as we understand what we are talking about and we communicate with others, we are going to make progress.

Another thought that came from the symposium discussions is that "surface management" is probably a much better term than "surface protection." The ultimate protection is up to all of us as managers, users, and landlords.

APPENDIXES

Appendix A

Winter Off-Road Transport in Northern Alaska

Edwin M. Rhoads*

ABSTRACT
Accelerated exploration and development of arctic hydrocarbon and mineral resources has led to off-road travel and increased awareness of the effects of development on the environment. The most extensive exploration in arctic Alaska before the Prudhoe Bay discovery was in Naval Petroleum Reserve No. 4 (NPR-4). Travel was done largely in winter. Since passage of the National Environmental Policy Act, regulations have limited summer operations and controlled winter activities. Winter routeways in the Arctic are constructed by compacting snow and by applying water to form snow/ice pavement. South of the Brooks Range, conditions are different from those on the Arctic Slope. Although trees must not be destroyed in preparation of trails, techniques are designed to preserve ground surface and vegetation root structure.

For thousands of years, mankind has overcome the obstacles of soft ground and open water by crossing them when they are frozen.

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The preparation of winter routeways for hauling heavy tonnages in roadless areas of the North is relatively recent, beginning in the late 1920's with the advent of powerful tracked prime movers pulling large sleds. Subsequently the procedures of improving winter roads to permit operation by trucks and wheeled trailers has been employed in the northern frontiers of both hemispheres. Following World War II, the stepped-up exploration and development of hydrocarbon and mineral resources in these regions increased the tempo of off-road movement, and also aroused an awareness of the environmental effects of these activities.

Alaska north of the Yukon River is the scene of extensive exploration activity in an area virtually devoid of all-weather roads. The Brooks Range and its westerly extensions separate two distinctive subregions. To the north of these peaks lies the so-called Arctic Slope. The Arctic Foothills consist of low mountains, plateaus, and highlands of generally rolling topography, with relief from 150 to 1000 meters. Extending northward is the lake-studded Arctic Coastal Plain, of low relief with slopes generally less than 8 percent gradient. The Brooks Range itself is a spine of rugged mountains with the highest summits above 3000 meters, and local relief exceeding 1000 meters. More than 80 percent of this area exceeds 8 percent in grade. The relief and ruggedness is somewhat modified in the westerly extensions and on the Seward Peninsula. South of the Brooks is a region of low mountains and rolling uplands, with intervening river basin plains and lowlands. Relief of 100 to 1000 meters is encountered in the hills and uplands, with more than half of the surface exceeding 8 percent in slope. The plains and lowlands are generally flat or gently sloping with relief generally less than 30 meters. (Fig. 1 shows the physiographic provinces of Alaska [from Johnson and Hartman 1969].)

The climate of the Arctic Slope features long cold winters, with mean January winter minimums around -30°C, short cool summers with July maximums of 8° to 10°C, and a mean annual temperature around -12°C. Precipitation is quite low, around 10 to 25 cm per year, and winds are frequent. Winter snowfall may exceed the 50 to 100 cm range, but is swept and drifted by the predominant easterly and westerly winds. Permafrost is continuous and deep throughout, except under large water bodies. South of the Brooks Range, a continental climate prevails, with colder winter and warmer summer temperature extremes, and mean annual temperatures ranging from -5° to -10°C. Annual precipita-

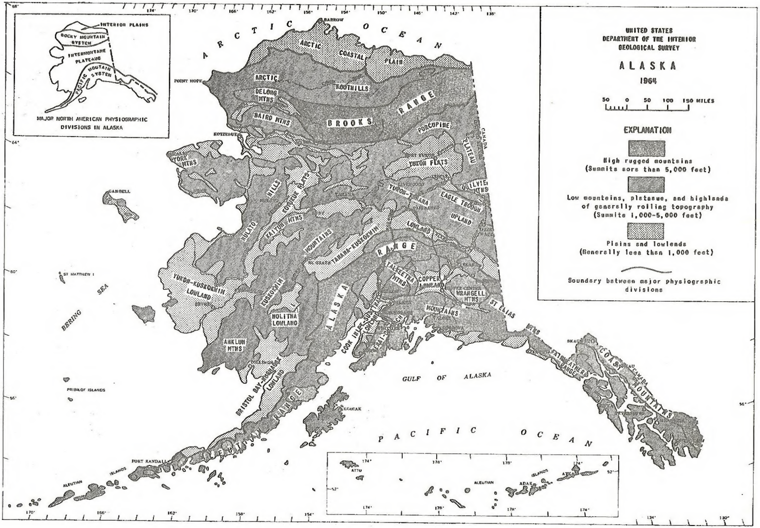

Fig. 1. Physiographic provinces of Alaska (from Wahrhaftig. U. S. Geological Survey 1964 in Johnson and Hartman 1969).

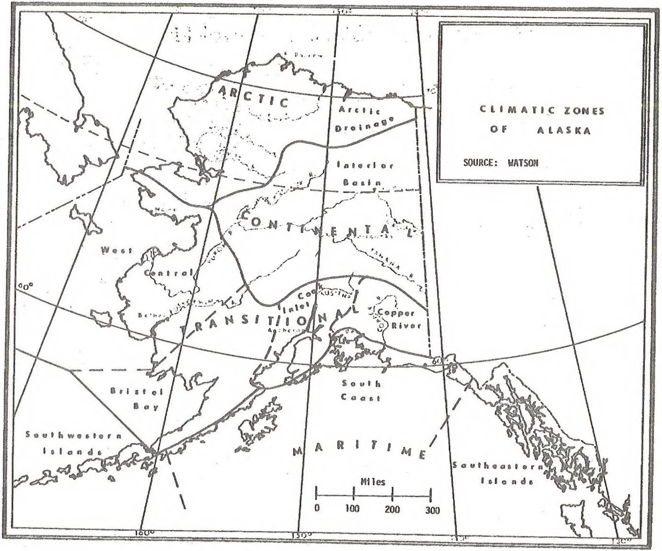

Fig. 2. Climatic zones of Alaska (from Watson in *Johnson and Hartman 1969).*

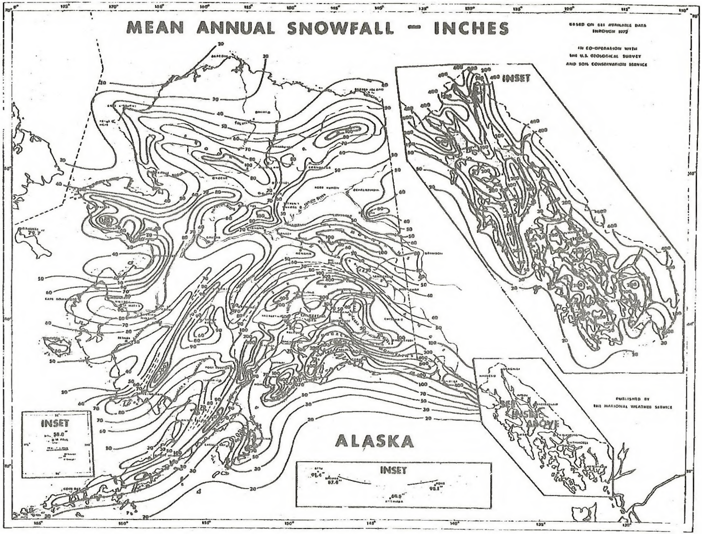

Fig. 3. Mean annual snowfall in inches in Alaska (from Alaska Rural Development Council Publication 1. 1974).

tion ranges from 25 to 50 cm, producing from 125 to 200 cm of snow during an average winter. Winds are less frequent, resulting in a deeper snow cover overall than on the Arctic Slope. Permafrost is discontinuous in the eastern half of this subregion, and generally continuous in the western portion (Figs. 2 and 3).

The pattern of dominant vegetation cover in northern Alaska is divided markedly by the tree line on the southern slopes of the Brooks Range, and extends around the neck and southern portion of the Seward Peninsula. The treeless region to the north is comprised of wet sedge-and-grass tundra in the Arctic Coastal Plain and northern Seward Peninsula, moist cottongrass tundra and brush in the Arctic Foothills and Central Seward Peninsula, and predominantly barren alpine tundra in the Brooks Range and westward extensions. The forested area consists primarily of closed spruce-hardwood and low, open spruce, interspersed with wet muskeg areas of varying extent (Fig. 4).

The most intensive winter off-road activities in northern Alaska are carried out in connection with exploration for petroleum and natural gas. These hydrocarbons are found in tectonic depressions, the location of which is shown in Fig. 5. Of these, the Cook Inlet and Sagavanirktok basins contain the largest proven reserves to date. The Naval Petroleum Reserve No. 4 is located entirely in the Colville geosyncline. Currently, major explorations are under way in the blocks marked A and B in Fig. 5. By congressional authority, a private corporation, Husky Oil, under federal supervision (currently Department of the Navy, to be succeeded by the Interior Department) is carrying out an exploratory drilling program in Block A (hereafter designated as "Lonely"). Under an agreement with the Doyon Native Regional Corporation, the Louisiana Land and Exploration Company is doing likewise in Block B (hereafter called "Kandik") (Fig. 5).

The most extensive arctic exploration program in Alaska prior to the 1968 Prudhoe Bay oil discovery was that conducted by the Navy from 1944 to 1953 in PET-4. Heavy overland freighting was done, of necessity, in the winter, with D-8 crawler tractors pulling three or four 20-ton Michler bobsleds apiece (Fig. 6). Geological and geophysical exploration was conducted in summer with aircraft and Weasels, and in winter with light, pipe-frame sleds towed by tractors. Winter trails were prepared by plowing to attain a surface to achieve maximum efficiency (tonnage per tractor). Though the PET-4 operation was accomplished

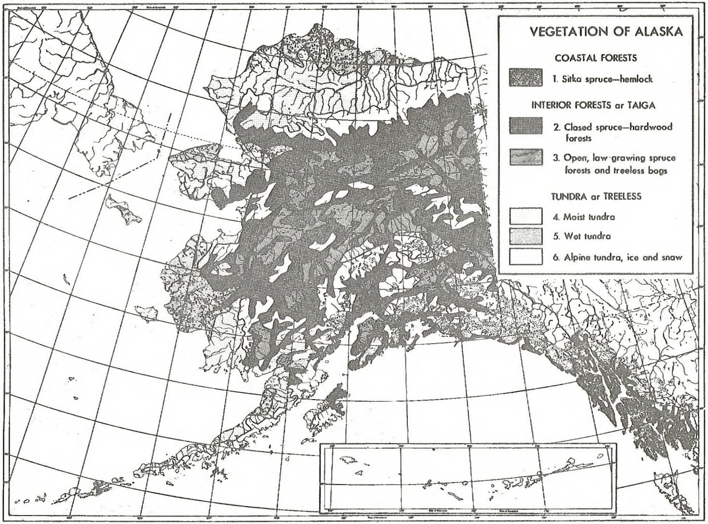

Fig. 4. Potential natural vegetation in Alaska (from U. S. Geological Survey. National Atlas of the United States of America 1970).

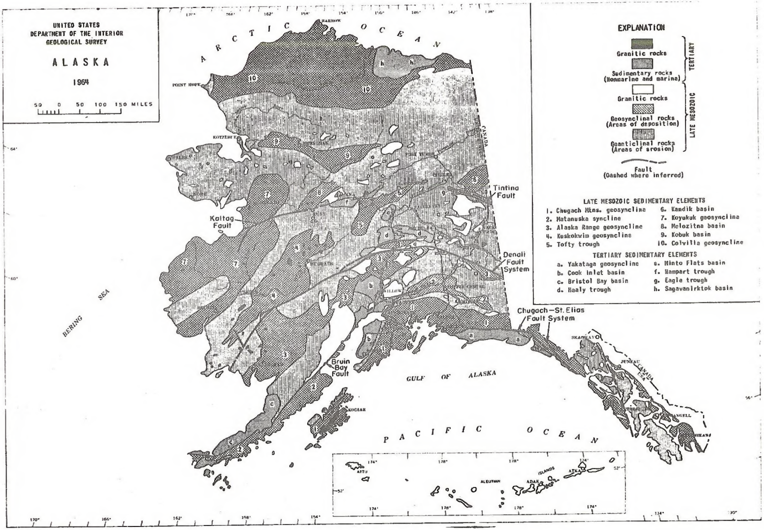

Fig. 5. Tectonic Map of Alaska (from U. S. Geological Survey 1964 in Johnson and Hartman 1969).

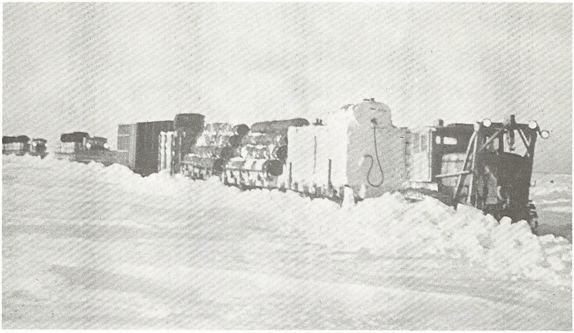

Fig. 6. Caterpillar tractor train on PET-4, March 1950.

with a high record of effectiveness, economy, and safety, the after-effects of long-standing scars on the landscape are well documented (see Hok 1969) (Fig. 7).

The 1969 rush to the Prudhoe field coincided with the signing of the National Environmental Policy Act, and in the ensuing years, regulatory measures for off-road movement over Federal and State lands have been formulated. In general, these regulations severely limit summer operations and place stringent controls on winter operations to preserve the root structure of the vegetation cover and prevent thaw subsidence and erosion.

The two principal techniques for preparing winter routeways to support heavy equipment are (a) the compaction of snow to an adequate density and (b) the application of water to form snow/ice pavement on a subgrade of frozen ground. The former is employed normally for long distance and less frequently traveled trails, and the latter for shorter, heavy-use haul roads. The availability of snow and water is critical. Where there is insufficient snow on the trailway, snow may be procured by hauling, use of drift fencing, or even by manufacturing it. Water, of necessity, must be obtained from an unfrozen source and transported to the route.

Fig. 7. Surface degradation resulting from damage to tundra vegetation mat by vehicle operation. (Photo by Jerry Hok)

The operational area around Lonely is shown in Fig. 8. Maximum use is made of natural fresh and salt-water ice. All movement on unprepared routes is done with the RD 85 Bechtel Rolligon, an articulated vehicle of 15-ton capacity riding on low-pressure pneumatic rollers. Snow trails are prepared by all-terrain vehicles such as this Delta 3, with snow blades, using snow construction techniques to bridge obstacles (Fig. 9). A field camp mounted on sleds or Nodwell trailers towed by crawler tractors follows (Fig. 10). When the compacted snow has sintered to a density of 0.6, heavy tracked and wheeled equipment can proceed to the construction site. Preparation of the heavy-duty haul road to the borrow and water point for the drill is accomplished by compacting at least 15 cm of unconsolidated snow to permit all-terrain vehicles carrying 12,000-liter insulated water tanks to operate. Water is applied in successive lifts, each being allowed to freeze before the next is applied. A roadway 7.3 meters in width with an ice thickness of 20 to 25 cm is sufficient for sustained use by heavy earth-moving equipment such as wheeled scrapers and 20 cubic meter end dump trucks. Water quantities on the order of 1.5×10^6 liters per kilometer are required for this type of construction. Heavy tracked equipment is kept off these roads as much as possible to avoid chipping and cracking of the ice surface.

South of the Brooks Range, the sharper relief, greater biomass, generally deeper snow cover, and a lesser abundance of water bodies present different operational conditions. Pushing trails through the spruce-forested areas inevitably destroys the trees in the path, leaving visible

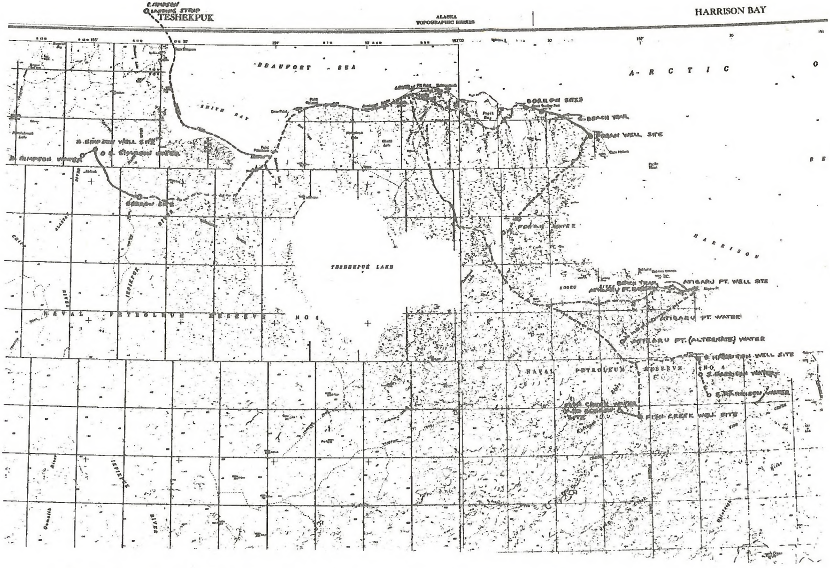

Fig. 8. Husky Oil Company Exploration Program, NPR-A.

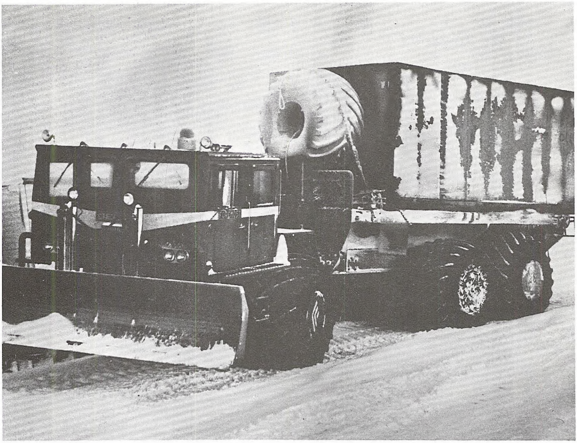

Fig. 9. Foremost "Delta 3" all-terrain vehicle with snow blade.

evidence of the activity for many years. However, the operation can be conducted in a manner which preserves the ground surface and root structure of shrubs and low-lying plant life.

Fig. 11 shows the location of exploratory drilling activities in the Kandik Basin between the Yukon and Porcupine Rivers. In this area, initial trail preparation consists of "walking down" the standing vegetation with tracked vehicles after the root structure of the vegetation mat has frozen solidly (a depth of 30 cm or so), and 30 cm or more of snow has accumulated. This process breaks off the frozen trees and woody plants above the ground surface. In the Kandik Basin, seismic exploration was conducted for several winters preceding the exploratory drilling begun during the winter of 1975-76. The seismic

Fig. 10. Sled-mounted mobile field camp.

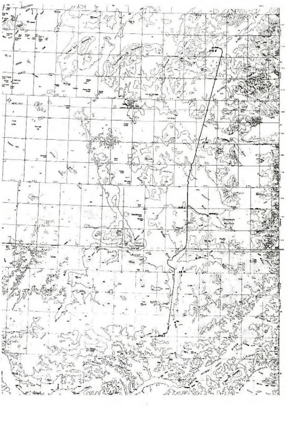

Fig. 11. Louisian Land and Exploration Company exploration program, Kandik Basin.

Fig. 12. Dragging snow trail with a payloader.

field parties used Nodwell vehicles extensively, and D-7 Caterpillar tractors for initial trail clearing in heavily wooded areas. These trails or "seis lines" are about 2.5 meters wide and literally "straight as a string."

Snow trails for heavier equipment use the existing seis lines to the maximum possible extent, deviating only to avoid difficult stream crossings or grades in excess of 15-20 percent. The trail is widened to 4.3 m by "walking down" with D-7's, and the grade smoothed with a drag made of 8-inch (20.3 cm) drill casing (Fig. 12). Snow berms and debris along the edges are bladed back onto the trail. This dragging breaks up and crushes the debris, mixing it with the snow to form a mulch. Depressions are filled with snow and brush and stream crossings reinforced with brush riprap. After a sintering period of 48 to 72 hours, depending on temperatures, the trail is suitable for 10-ton sled loads, D-7 tractors, and light wheeled vehicles (Fig. 13). The last tractor of a convoy or "swing" pulls a drag to smooth out ruts for the next traverse, thereby continually maintaining the trail.

For the movement of very heavy loads, the snow trail may be compacted to 0.5 m or more, or the surface shaped with a grader and capped with ice. The latter is accomp-

Fig. 13. Completed snow trail, Kandik Basin, January 1977.

D-8 bulldozer on ice-snow road.

lished by using 20,000-liter tank trucks fitted with splatter boards, standard oil-field equipment. Each truck has its own onboard suction pump for refilling, permitting rapid turn-around. The application of 75 to 100 x 10^3 liters [of water] per km of trail is sufficient to soak into the top 5 to 8 cm of compacted snow, forming a satisfactory pavement. In extremely low temperatures, around -40° to -50°C, snow may be windrowed in the trail and watered. The resulting mix is then spread with a grader, forming a smooth surface which cures rapidly by freezing. When there is insufficient snow to prepare the initial snow road, the vegetation is walked down as above and an ice pavement laid down, which will require more water per kilometer. This was the case for the first 25 km or so of the ice/snow road from Site 1 to Site 2 in the Kandik.

The haul road for borrow material and water for the drill must be wider and more durable to withstand sustained two-way traffic. At Site 2, a 13 km, 7 m wide road was constructed on a compacted snow base by the application of 1.25 x 10^6 liter of water per kilometer. As on the Arctic Slope, crawler tractor operation is kept to a minimum to protect the ice surface. Due to the rolling topography, grades must be dusted with fines from the borrow to provide traction for the truck-tractor belly dumps hauling fill material (Fig. 14).

This has been a brief description of techniques currently employed in the coastal tundra of Alaska's Arctic Slope and in the forested interior north of the Yukon River for winter off-road transportation. In each case, disturbance of the land surface and vegetation root structure has been avoided and the ground vegetation mat left intact to the maximum possible extent. Past experience has shown that vegetation regrowth after melt-off is rapid, resulting in a strip greener than its surroundings. Where winter kill occurs due to the higher thermal conductivity of the ice and compressed snow, the intact surface and mat of dead vegetation still prevent thermal degradation and erosion.

References

Adam, Kenneth M. 1974. Impact from winter road use and misuse. Pages 29-36 in Research Reports. Vol. IV. Environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta. Environmental Protection Board, Winnipeg, Canada.

Alyeska Pipeline Se_vice Co. 1974. Construction pad analytical study: Design criteria for snow/ice work pad. Report No. CPA-028, Alyeska Pipeline Service Co., Anchorage, Alaska. (Drawn extensively from USA CRREL sources.)

Brewer, Max C. Husky Oil NPR Operations, Inc. Anchorage, Alaska. Personal communication.

Evans, Margaret N., ed. 1976. Proceedings of the Surface Protection Seminar, Jan. 19-22, 1976, Anchorage, Alaska. Bureau of Land Management, Alaska State Office, Anchorage, Alaska. 298 pp.

Green Construction Co. (undated). The construction and use of snow roads and snow work pads. El Paso Alaska Co., Anchorage, Alaska.

Hok, Jerome R. 1969. A reconnaissance of tractor trails and related phenomena on the North Slope of Alaska. U. S. Dep. of Interior, Bureau of Land Management, Fairbanks, Alaska. 65 pp.

Johnson, Philip. U. S. Army Cold Regions Research & Engineering Laboratory (USA CRREL), Fairbanks Office. Fairbanks, Alaska. Personal communication.

Johnson, Philip R., and Charles W. Hartman. 1969. Environmental atlas of Alaska. Inst. of Arctic Environmental Engineering, University of Alaska, College, Alaska.

Kevan, Peter G. 1971. Vehicle tracks on high arctic tundra. Plant Research Institute, Ottawa, Ontario, Canada. Supported by the Defense Research Board of Canada. 17 pp.

Keyes, Donald E. 1976. Ice and snow construction workpads, roads, airfields and bridges. Dep. of Interior, Alaska Pipeline Office, Anchorage, Alaska.

Klein, R. M., W. M. Lyle, P. L. Dobey, and K. M. O'Connor. 1974. Energy and mineral resources of Alaska and the impact of federal land policies on their availability. Oil and gas. Alaska Open File Report 50. Division of Geological and Geophysical Surveys, Dep. of Natural Resources. Energy Resources Section, State of Alaska, Anchorage, Alaska. 24 pp.

O'Grady, Thomas J., II. 1976. Ice roads on Alaska's North Slope. Term Paper, EM 684, Dep. of Engineering Management, University of Alaska, Fairbanks, Alaska (sources include USA CRREL).

Reed, John C., Jr. 1958. Exploration of Naval Petroleum Reserve No. 4 and adjacent areas northern Alaska, 1944-1953. Part I, History of the Exploration. U. S. Geol. Survey Prof. Paper 301. 192 pp. pls. 3. 101 illustr. Washington, D. C.

Taylor, James W., consultant, Louisiana Land and Exploration Co., Anchorage, Alaska. Personal communication.

Appendix B

TECHNICAL NOTE

Ground Pressures Exerted by Underground Explosions

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December 20, 1977

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ABSTRACT
Peak shock pressures in frozen soil resulting from underground explosions of moderate size and their effect on fish populations are examined, based on current knowledge of shock pressure patterns and the sensitivity of fish eggs and young and adult fish to such pressures. The peak shock pressures attenuate rapidly with distance from explosion and it appears that moderate-sized explosions, such as those from standard seismic shots, can be fired within a few hundred feet of water bodies without exceeding allowable peak shock pressures in the water bodies. Experimental studies should be carried out to confirm the pattern of peak shock pressure attenuation and examine the effectiveness of shock transmission between frozen ground and the water bodies.

INTRODUCTION

Underground explosions, such as those used for seismic exploration, generate shock pressures in a radiating pattern. If fired at or near a body of water containing fish, the shock pressures may affect the fish. Uncertainty regarding the magnitude of such pressures has led to widely varying estimates of the separation distance which must be maintained between shot holes and water bodies.

Several factors are involved. The most important are the unit weight and yield of the explosive, the effectiveness of energy transmission from the explosive to the frozen soil and from the frozen soil to the water, the pattern of shock pressure in the ground and the sensitivity of fish eggs and young and mature fish to shock pressure.

This report uses relations published by Mellor (1) to estimate the shock pressure patterns in frozen soil. It is not able to predict the transmission effectiveness between the soil and a water body.

Interest is concentrated on explosions the size of normal seismic shots which consist of 100 lbs of 60% powder.

Grundy (2) indicated that an overpressure of 40 psi will kill fish while 2 psi will affect eggs and alevin.

ACTION OF EXPLOSIVES (condensed from Mellor [1])

An explosion involves the very rapid generation of energy in a limited space with the sudden development of great pressure, usually accompanied by a violent gas expansion. A chemical explosive generates a great amount of energy--approximately 1 kcal/g--is released in a very short time (microsecond reaction time), so that the power level is enormous (about 50 billion kilowatts per square meter at the detonation front). Chemical explosives undergo exothermic reaction, propagating a reaction from the point of initiation. Detonation pressure (which can exceed 30,000 atmospheres in some explosives) is approximately proportional to the square of the detonation velocity.

When fired inside a solid or fluid medium, an explosion creates a severe shock wave which initially propagates radially outward from the charge at a speed higher than the acoustic velocity of the medium.

In many materials only a minor proportion of the total explosive energy is transmitted in the shock wave - typically less than 20% in common rocks and sometimes only a few percent.

The spherical wave propagating from a point charge in an isotropic infinite medium attenuates geometrically with wave amplitude (inversely proportional to radius) and wave energy (inversely proportional to radius squared). The wave also attenuates because of internal energy dissipation in the medium with amplitude decreasing exponentially with distance traveled. The combined attenuation is best described by a function with an inverse proportionality factor and an exponential decay factor but in practice it is usual to plot shock pressure against scaled radius on logarithmic scales and express the result approximately as a simple power relation, with amplitude inversely proportional to radius raised to a power of roughly 2 to 3.

It is convenient to scale shock and blast effects to remove the effect of charge size when characterizing the properties of explosives and the blast response of materials. In ordinary blasting practice, dynamic and geometric similitude permits linear dimensions such as charge depth, burden, hole spacing, crater radius, etc. to be normalized with respect to charge radius for a given type of explosive. For a given charge density, charge volume is proportional to charge weight and it has become usual to scale linear dimensions with respect to the cube root of charge weight, i.e. a length measured in feet is divided by the cube root of charge weight measured in pounds to give a

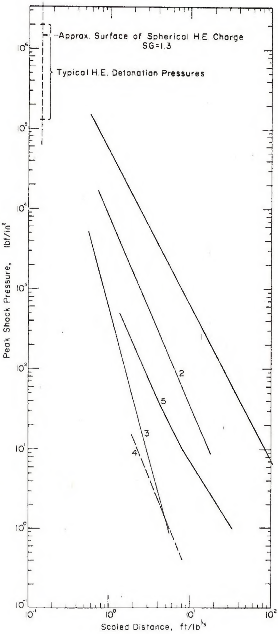

Fig. 1. Stress wave attenuation in various materials: 1) granite, 2) glacier ice, 3) ice-cap snow, 4) seasonal snow, 5) air. (See Mellor 1968 and 1972 for details of data sources.) From Mellor (1)

scaled length expressed in units of ft/lb$^{1/3}$.

STRESS WAVE ATTENUATION

Figure 1 from Mellor (1) shows stress wave attenuation in various materials. Aitken, a CRREL engineer who has been working with explosions in permafrost (3), advised that data from frozen fine-grained soils falls between lines 2 and 5 in this figure. Consequently, it is conser-

Table 1. Peak ground shock pressures resulting from varying distances and charge weights.

Ft.	Charge Weight (Pounds)						
	10	25	50	100	250	500	1000
10	217	441	754	1290	2620	4480	7660
20	43	88	150	256	521	891	1520
30	17	34	58	100	202	346	596
50	5.1	10	18	30	62	105	180
100	1.0	2.1	3.5	6.0	12	21	36
200	.20	.41	.70	1.2	2.4	4.2	7.1
300	.08	.16	.27	.47	.95	1.6	2.8
500	.02	.05	.08	.14	.29	.49	.81
1320	---	.01	.01	.01	.03	.05	.09
2640	---	---	---	---	.01	.01	.02

vative to use line 2 as is done in this paper. The equation of line 2 is

$$Y = 7800 X^{-2.33} \qquad (1)$$

where Y is peak shock pressure in psi and X is the scaled distance in $ft/lb^{1/3}$. This relationship can also be expressed in terms of the primary parameters

$$Y = 7800 W^{.774} L^{-2.33} \qquad (2)$$

where W is weight of explosive in pounds and L is slant distance in feet. This equation was solved for various combinations of W and L. The results are shown in Table 1.

Table 1 must be used with certain reservations, particularly with peak pressures less than 10 psi. Line 2 in Figure 1 extends down only to 10 psi so all values below that point are extrapolations. However, the behavior of

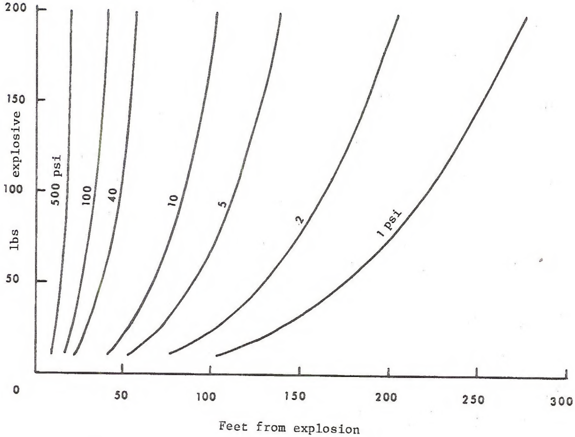

Fig. 2. Lines of equal peak shock pressure.

lines 3 and 4 indicate that extrapolation to perhaps 1 psi should not lead to serious error, particularly as the relationship used is already conservative. Values below 1 psi are speculative.

Equation 2 can be rearranged to solve for the distance at which a given peak shock pressure occurs with a given charge weight. The relationship is:

$$L = \frac{47.2\ W^{1/3}}{Y^{.43}} \qquad (3)$$

Figure 2 shows lines of equal peak shock pressure for various combinations of charge weight and slant distance.

DISCUSSION AND CONCLUSIONS

Table 1 and Figures 1 and 2 represent the current state-of-art and provide a basis for evaluating peak shock pressures in frozen ground resulting from underground explosions of moderate size. Tests carried out by CRREL engineers on frozen fine-grained soils in the Fairbanks

area indicate that the approach and general magnitudes are reasonable. Table 1 shows that the attenuation of the peak shock pressure is very rapid. For example, with a standard seismic charge of 100 lbs, these pressures are 31, 6.1, and 1.2 psi for distances of 50, 100, and 200 feet, respectively. Doubling the distance reduces the peak shock pressure by a factor of five.

Figure 2 shows that, for the standard seismic charge of 100 lbs, the peak shock pressure falls to 40 psi in slightly less than 50 feet and to 2 psi in slightly over 150 feet. If a factor of safety is desired, it falls to 1 psi at slightly over 200 feet. Figure 2 also shows that it would be difficult to generate a peak shock pressure of 40 psi at 100 feet unless a very large quantity of explosive were used. Similarly, a peak shock pressure of 2 psi would be difficult to generate at 300 feet without a large charge.

The problem of transmitting shock pressure across the frozen groundwater interface is of interest and importance. Only lakes and rivers that do not freeze to the bottom during the winter will contain fish populations. Such bodies of water will have a zone of thawed soil under the water. The pressure wave arriving at the body of water will have a complicated system to cross since it must cross the interface between the frozen and unfrozen soil, then the thawed soil, and finally the interface between the thawed soil and the water. It seems probable that various reflective, refractive, and other processes would reduce the amplitude of the wave by the time it reached the water.

It would be highly desirable to conduct a series of properly instrumented series of shots under winter conditions on the North Slope to measure the real over pressures and to examine the effectiveness of shock pressure transmission into bodies of water.

References

1. Mellor, M., 1972, Controlled release of avalanches by explosives, reprint from Advances in North American Avalanche Technology: 1972 symposium, Reno, Nevada.

2. Grundy, S., 1977, Statement at surface protection seminar, Anchorage, Alaska, 17-20 May 1977.

3. Aitken, G., Personal communication, 24 May 1977.

Symposium Attendance

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